INSTRUCTION MANUAL

Serial Number B153752

also 7B70

7B50 TIME BASE

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Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

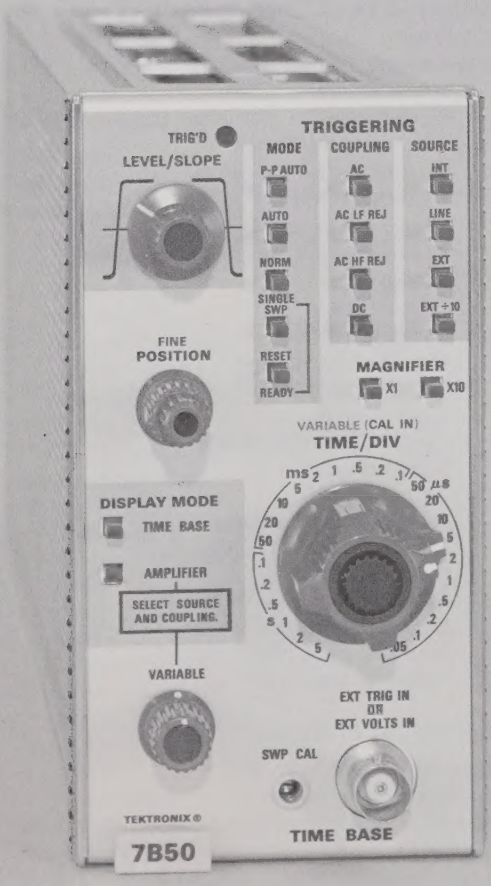


Fig. 1-1. Type 7B50 Time Base.

SECTION 1
SPECIFICATION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

The Type 7B50 Time Base unit is designed specifically for use with Tektronix Type 7500-Series Oscilloscopes; however, it is also compatible with all other 7000-Series Oscilloscopes. The Type 7B50 features calibrated sweep rates from 5 seconds/division to 0.05 microseconds/division (5 nanoseconds/division with MAGNIFIER at X10), triggering to 100 megahertz or vertical amplifier bandwidth, whichever is less and an external horizontal amplifier. Sweep rates may be varied continuously (uncalibrated) between calibrated steps. The sweep free-runs providing a bright base-line in the absence of adequate triggering signal in P-P AUTO and AUTO triggering modes.

The Performance Check procedure given in Section 5 provides a convenient method of checking performance of this instrument. The following electrical characteristics apply at an ambient temperature of 0°C to +50°C, unless otherwise noted. Warmup time for given accuracy is 20 minutes.

TABLE 1-1

ELECTRICAL CHARACTERISTICS

Characteristic	Performance			
Sweep Rate				
Calibrated Range	5 s/div to 0.05 µs/div, steps in a 1-2-5 sequence. X10 magnifier extends sweep rate to 5 ns/div.			
VARIABLE Range	Continuously variable between calibrated steps. Extends sweep rate to at least 12.5 s/div.			
Sweep Accuracy	Measured in 7500 series mainframe. Calibrated with mainframe calibrator.			
Time Interval	+15°C to +35°C		0°C to +50°C	
Over Center 8 div	Unmag	Mag	Unmag	Mag
5 s/div to 0.1 s/div and 0.2 µs/div to 0.05 µs/div	3%	3.5%	4%	5%
50 ms/div to 0.5 µs/div	2%	2.5%	3%	4%
Over any 2 div interval within center 8 div	5%		7%	

Characteristic	Performance	
Exclude following portions of Magnified Sweep	Start of Sweep first 50 ns	End of Sweep beyond the 100th div
Sweep Length	10 divisions to 13 divisions	
Sweep Hold-Off Time		
5 s/Div to 5 µs/Div	1.5 times the TIME/DIV setting or less.	
2 µs/Div to 0.05 µs/Div	3.5 microseconds or less.	
External Horizontal Amplifier		
Deflection Factor		
EXT		
VARIABLE fully clockwise	90 millivolts/division within 10 millivolts/division	
EXT ÷ 10		
VARIABLE Fully clockwise	900 millivolts/division within 110 millivolts/division	
VARIABLE Range	At least 10 to 1	

Characteristic	Performance		
Nominal Frequency Response	System −3 dB points in 7500-series oscilloscopes		
	Lower −3 dB	Upper −3 dB	
AC	16 Hz	500 kHz	
AC LF REJ	70 kHz	500 kHz	
AC HF REJ	16 Hz	100 kHz	
DC	DC	500 kHz	
Trigger Sensitivity	Triggering Frequency Range[1]	Minimum Triggering Signal Required	
Coupling		INT	EXT
AC	30 Hz to 10 MHz	0.3 Div	150 mV
	10 MHz to 100 MHz	1.5 Div	750 mV
AC LF REJ	30 kHz to 10 MHz	0.3 Div	150 mV
	150 kHz to 10 MHz		150 mV
	10 MHz to 100 MHz	1.5 Div	750 mV
AC HF REJ[2]	30 Hz to 50 kHz	0.3 Div	150 mV
DC	DC to 10 MHz	0.3 Div	150 mV
	10 MHz to 100 MHz	1.5 Div	750 mV
Single Sweep	Triggering requirements same as normal sweep. When triggered, sweep generator produces one sweep only.		
Internal Trigger Jitter	1 nanosecond or less at 75 megahertz		

[1] On internal triggering only, the specified −3 dB frequency of the vertical system replaces any frequencies in the above table when the number in the table is greater than the vertical amplifier upper −3 dB point.

[2] Will not trigger on sine waves of 3 divisions or less internal or 1.5 volts external below 120 Hertz.

Characteristic	Performance
External Trigger Input	
Maximum Input Voltage	500 V (DC + Peak AC). 500 V P-P AC at 1 kilohertz or less
Input R and C	1 megohm within 2%, 20 picofarads within 2 picofarads
Level Range (excluding P-P AUTO)	
EXT	At least +3.5 volts to −3.5 volts
EXT ÷ 10	At least +35 volts to −35 volts
Bright Base-Line	Sweep free-runs in absence of triggering signal in AUTO and P-P AUTO
P-P AUTO Operation	
Sensitivity	0.5 div internal, 250 mV external 200 Hz to 10 MHz. 1.5 div internal, 750 mV external 10 MHz to 100 MHz

ENVIRONMENTAL CHARACTERISTICS

TABLE 1-2

Characteristic	Performance
Altitude	
Non-Operating	To 50,000 feet and −55°C
Transportation	Qualified under National Safe Transit Committee test procedure 1A, Category II

PHYSICAL CHARACTERISTICS

TABLE 1-3

Characteristic	Performance
Finish	Front Panel is anodized aluminum
Dimensions	14 1/4 inches long by 2 5/8 inches wide by 5 inches high overall
Weight	About 1 3/4 pounds

SECTION 2
OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of the manual.

General

The Type 7B50 plug-in unit operates with a Tektronix 7000-series indicator oscilloscope and a 7A-series vertical plug-in unit to form a complete oscilloscope system. To effectively use the Type 7B50 its operation and capabilities should be known. This section describes the operation of the front-panel controls, gives first-time and general operating information and lists some basic applications for this instrument.

Installation

The Type 7B50 is designed to operate in the horizontal plug-in compartments of Tektronix 7000-series oscilloscopes. The Type 7B50 can also be installed in a vertical plug-in compartment to provide a sweep that runs vertically on the CRT. However, when used in this manner, there is no retrace blanking or internal triggering provision and the unit may not meet the specifications given in Section 1. The instructions in this manual are written for use of the Type 7B50 in a horizontal plug-in compartment of the oscilloscope.

When the Type 7B50 is used with an oscilloscope which has two horizontal plug-in compartments, install this unit in The B (right)compartment. Then, if a delaying-sweep unit is installed in the A (DELAYING TIME BASE) compartment, delayed-sweep operation is available. The Type 7B50 will operate properly in the A compartment for all horizontal modes of operation except delaying sweep.

To install the Type 7B50 into a plug-in compartment, push it in until it fits firmly into the indicator plug-in compartment. To remove, pull the release latch (see Fig. 2-1) to disengage the unit from the indicator and pull it out of the plug-in compartment. Even though the horizontal gain of the indicator oscilloscope is standardized to minimize adjustment when inserting plug-in units, the sweep calibration of the Type 7B50 should be checked when it is inserted into the indicator to verify measurement accuracy. The procedure for checking the unit is given under Sweep Calibration Check in this section.

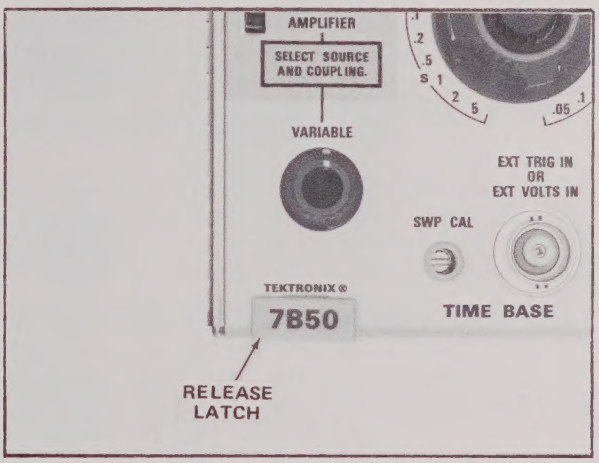


Fig. 2-1. Location of release latch.

FRONT-PANEL CONTROLS AND CONNECTORS

General

All controls required for the operation of the Type 7B50 are located on the front panel of the unit (see Fig. 2-2). To make full use of the capabilities of this instrument, the operator should be familiar with the function and use of each of these controls. A brief description of the front-panel controls and connector is given here. More detailed information is given under General Operating Information.

Triggering Controls

LEVEL/SLOPE — Selects the amplitude point and slope of trigger signal on which the sweep is triggered. When the indicator line on the outer ring is to the left of center, the sweep is triggered on the positive-going slope of the trigger signal, as shown by the positive-going waveform. To the right of center, the sweep is triggered on the negative-going slope of the trigger signal as shown by the negative-going waveform.

TRIG'D — Light indicates that the sweep is triggered and will produce a display with correct setting of the POSITION control and the controls on the associated vertical unit and indicator oscilloscope.

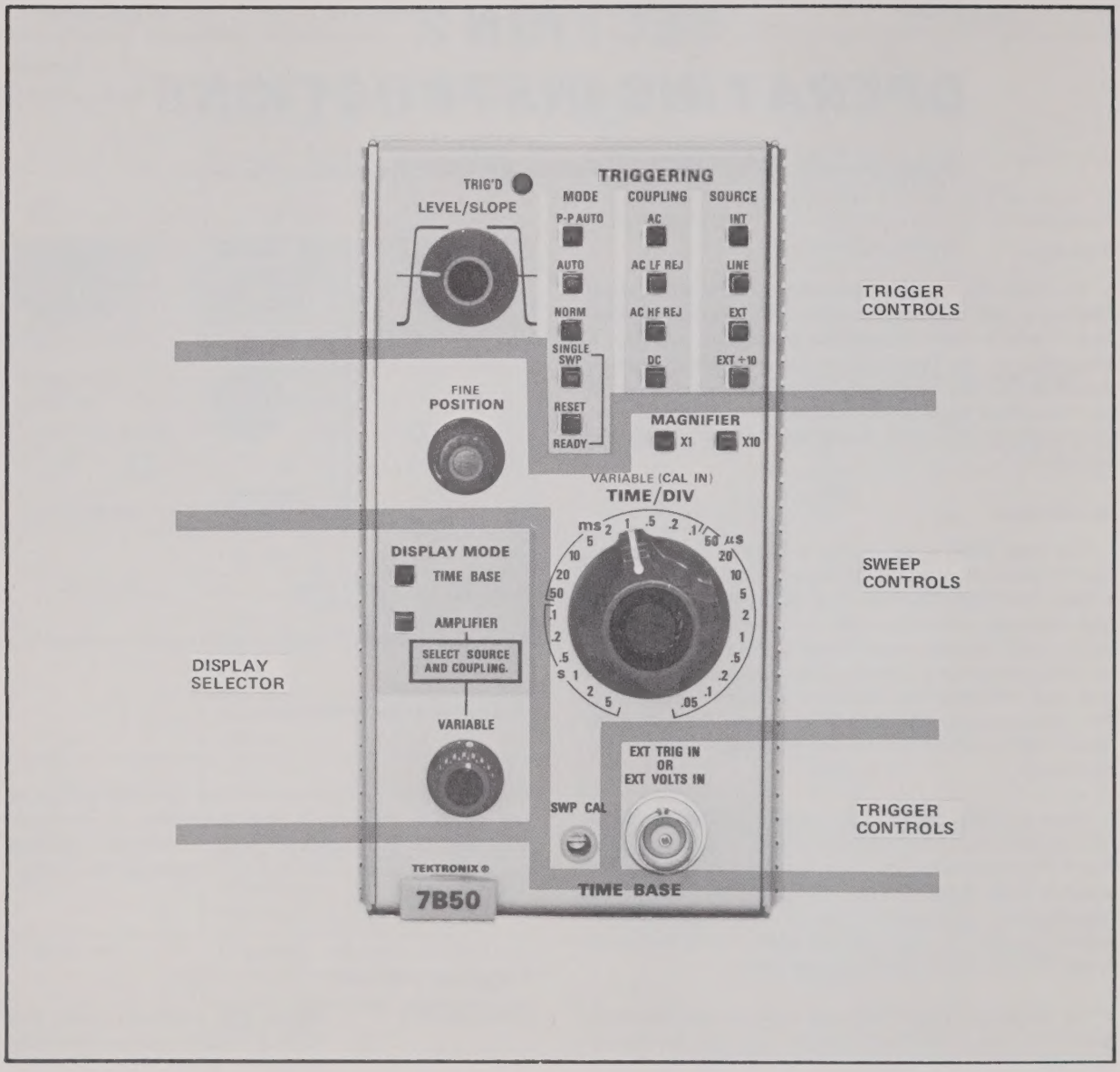


Fig. 2-2. Front-Panel controls and connector.

MODE

Series of push-button switches to select the trigger mode. Selected mode is indicated by lighted button.

P-P AUTO: Sweep automatically triggered at point selected by the LEVEL/SLOPE control when the trigger signal repetition rate is above about 200 hertz and within the frequency range selected by the COUPLING switch. Triggered sweep can be obtained throughout the entire range of the LEVEL/SLOPE control. When the trigger repetition rate is below the lower frequency limit (or above upper limit for AC HF REJ) or when the trigger signal is inadequate, the sweep free runs at the sweep rate selected by the TIME/DIV switch to produce a reference trace.

AUTO: Sweep initiated by the applied trigger signal at point selected by the LEVEL/SLOPE control when the trigger signal repetition rate is above about 30 hertz and within the frequency range selected by the COUPLING switch. Triggered sweep can be obtained only over the amplitude range of the applied trigger signal. When the LEVEL/SLOPE control is outside the amplitude range, the trigger repetition rate is below the lower frequency limit (or above upper limit for AC HF REJ) or the trigger signal is inadequate, the sweep free runs at the sweep rate selected by the TIME/DIV switch to produce a reference trace.

NORM: Sweep initiated by the applied trigger signal at any point selected by the LEVEL/SLOPE control over the frequency range selected by the COUPLING switch. Triggered sweep can be obtained only over the amplitude range of the applied trigger signal. When the LEVEL/SLOPE control is outside the amplitude range, the trigger repetition rate is outside the frequency range selected by the COUPLING switch or the trigger signal is inadequate, there is no trace.

SINGLE SWP: Sweep initiated by the applied trigger signal at any point selected by the LEVEL/SLOPE control over the frequency range selected by the COUPLING switch. Triggered sweep can be obtained only over the amplitude range of applied trigger signal. After the first sweep is displayed, further sweeps cannot be presented until the RESET-READY push-button is pressed. When the LEVEL/SLOPE control is outside the amplitude range, the trigger repetition rate is outside the frequency range selected by the COUPLING switch, the trigger signal is inadequate or when the RESET-READY light is off, there is no trace.

RESET-READY: Push-button to reset the Sweep Generator for the next sweep in the single-sweep mode. The RESET-READY button remains lighted to indicate that the unit is ready to be triggered. After the unit is triggered and a sweep is completed, the RESET-READY light goes out until the button is pressed again.

COUPLING

Series of push-button switches to select the trigger coupling. Selected coupling is indicated by lighted button.

AC: Rejects DC and attenuates AC signals below about 20 hertz. Accepts signals between 30 hertz and 100 megahertz.

AC LF REJ: Rejects DC and attenuates signals below about 30 kilohertz. Accepts signals between 30 kilohertz and 100 megahertz.

AC HF REJ: Accepts signals between about 30 hertz and 50 kilohertz. Rejects DC and attenuates signals outside this frequency range.

DC: Accepts all trigger signals from DC to 100 megahertz.

SOURCE

Series of push-button switches to select the trigger source. Selected source is indicated by lighted button.

INT: Trigger signal obtained internally from a vertical unit.

LINE: Trigger signal obtained internally from a sample of the line voltage applied to this instrument.

EXT: Trigger signal obtained from an external signal applied to the EXT TRIG IN connector.

EXT ÷ 10: Trigger signal obtained from an external signal applied to the EXT TRIG IN connector as in the EXT position. In this position the external signal is attenuated 10 times before it is applied to the trigger circuit.

EXT TRIG IN or EXT VOLTS IN	Input connector for external trigger signal or amplifier input signal.

Sweep Controls

POSITION	Controls horizontal position of display.
FINE	Provides more precise control of horizontal positions.
TIME/DIV	Selects the basic sweep rate of the output sawtooth. The VARIABLE control must be in calibrated position and MAGNIFIED switch set to X1 for indicated sweep rate.
VARIABLE	Two-position switch actuated by the VARIABLE knob to select calibrated or uncalibrated sweep rates. At the in position, the VARIABLE control is inoperative and the sweep rate is calibrated. When pressed and released, the knob moves out to activate the VARIABLE control for uncalibrated sweep rates. The sweep rate in each TIME/DIV switch position can be reduced to at least the sweep rate of the next adjacent position, to provide continuously variable sweep rates from 5 nanoseconds/division (X10-MAGNIFIER on) to about 12.5 seconds/division, with MAGNIFIER at X1.
MAGNIFIER	Push-button switches to select the horizontal magnification. The Selected magnification is indicated by a lighted button. X1:Magnified sweep at the basic sweep rate indicated by TIME/DIV switch. X10: Magnified sweep at a sweep rate 10 times faster than the basic sweep rate indicated by the TIME/DIV switch. The portion of the normal sweep within the center division of the graticule is the portion shown in magnified form.
SWP CAL	Screwdriver adjustment to set amplitude of the output sawtooth.

Display Mode

TIME BASE	Selects sweep rates as determined by TIME/DIV switch.
AMPLIFIER	Displays signals applied to the EXT TRIG IN or EXT VOLTS IN connector. Select TRIGGERING SOURCE and COUPLING.
VARIABLE (amplifier)	Varies deflection factor by a factor of 10.

TEST SETUP CHART

General

Fig. 2-3 shows the front panel of the Type 7B50. This chart can be reproduced and used as a test-setup record for special measurements, applications or procedures, or it may be used as a training aid for familiarization with this instrument.

GENERAL OPERATING INFORMATION

Sweep Calibration Check

Whenever the Type 7B50 is inserted into a plug-in compartment other than the one in which it was calibrated, the sweep calibration should be checked and readjusted if necessary. Allow five minutes warmup before performing this procedure.

1. Connect a one-kilohertz calibrator signal from the Indicator Oscilloscope Calibrator to the Vertical unit input connector.

2. Set the TIME/DIV switch to 1 ms and press the top TRIGGERING and DISPLAY MODE pushbuttons.

3. Set the Vertical unit to display at least two divisions of the signal vertically.

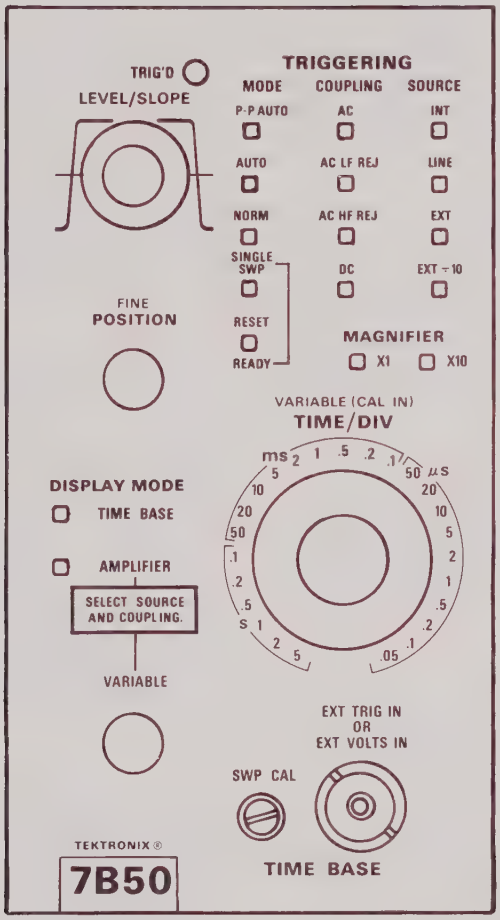
4. Check the CRT display for one complete cycle per division.

5. If necessary, adjust the SWP CAL adjustment for one complete cycle per division.

Simplified Operating Instructions

The following information is provided to aid in quickly obtaining the correct settings for the Type 7B50 to

7B50 TEST SET-UP CHART



NOTES:

Fig. 2-3.

present a display. The operator should be familiar with the complete function and operation of the unit as described in this section before using this procedure.

Normal Sweep. The following procedure will provide a stable display for most normal-sweep applications.

1. Select the TRIGGERING MODE, COUPLING and SOURCE which fit the requirements of the signal to be displayed.

2. Turn the LEVEL/SLOPE control to the desired slope.

3. If the green TRIG'D light is not on, adjust the LEVEL/SLOPE control throughout the range of the selected slope until the TRIG'D light comes on. If the light does not come on at any setting of the LEVEL/SLOPE control, the trigger signal is inadequate or the COUPLING and SOURCE switches are set incorrectly.

4. Set the TIME/DIV switch and POSITION control for a display which remains on the display area horizontally (VARIABLE control should be in CAL position for calibrated sweep rates).

5. If the display does not start at the correct point on the waveform, readjust the LEVEL/SLOPE control for the desired triggering.

Magnified Sweep. A magnified-sweep display can be obtained as follows after a normal-sweep display is obtained as given in steps 1-5 above.

1. Adjust the POSITION control to move the area to be magnified within the center division of the CRT.

2. If necessary, change the TIME/DIV switch setting so the complete area to be magnified is within the center division.

3. Press the X10-MAGNIFIER push-button.

4. Use the fine range of the POSITION control to establish precise positioning of the magnified display.

Delayed Sweep. The following procedure can be used to obtain a delayed-sweep display when the Type 7B50 is used in an oscilloscope that has dual time base capabilities and when used with a companion delaying-sweep unit (A). Obtain a display as given in steps 1-5 under Normal Sweep. Then proceed as follows:

1. Press the B STARTS AFTER DELAY push-button on the A time-base.

2. Set the indicator oscilloscope horizontal mode to display the A time base.

3. Set the TIME/DIV switch of the Type 7B50 so the intensified zone on the display is the desired length (intensified zone will be displayed in delayed form). If the intensified zone is not visible, adjust the indicator intensity controls.

4. Adjust the A time-base DELAY TIME MULT dial to position the intensified zone to the portion of the display to be delayed.

5. Set the indicator oscilloscope horizontal mode to display the B time base (Type 7B50).

6. If a delayed sweep with less jitter is desired, press the A time-base B TRIGGERABLE AFTER DELAY push-button. The triggering controls of the Type 7B50 must be set to obtain a stable display.

Pushbutton Switch Logic

The TRIGGERING MODE, COUPLING and SOURCE switches and the DISPLAY MODE switch are arranged in a sequence which places the most often-used position at the top of each series of pushbuttons. With this arrangement, a stable normal-sweep display can usually be obtained by pressing the top push-buttons; P-P AUTO, AC, INT and TIME BASE. When an adequate trigger signal is applied, the unit is triggered as indicated by the illuminated TRIG'D light at any setting of the LEVEL/SLOPE control. If the TRIG'D light is not on, either the trigger signal applied to this unit from the vertical unit is inadequate or it is below the lower frequency limit of the AC COUPLING switch position. If the desired display is not obtained with the pushbuttons pushed in, other selections must be made. Refer to the following discussions or the instruction manuals for the associated indicator oscilloscope and vertical unit for more information.

Triggered Light

The TRIG'D light provides a convenient indication of the condition of the triggering circuits. If the TRIGGERING controls are correctly set and an adequate trigger signal is applied, the TRIG'D light is on. Under certain

conditions, the TRIG'D light may be off, indicating that the sweep is not triggered. The cause might be a misadjusted LEVEL/SLOPE control, incorrectly set COUPLING or SOURCE switches, low trigger signal amplitude, or a trigger signal repetition rate outside the acceptable frequency range. This feature can be used as a general indication of correct triggering. It is particularly useful when setting up the trigger circuits when a trigger signal is available without a display on the CRT. It also indicates that this unit is correctly triggered when operating as a delayed-sweep unit (B).

Trigger Mode

The pushbuttons located under the MODE title (see Fig. 2-4) select the mode in which the sweep is triggered. The selected mode is indicated by a lighted pushbutton.

P-P AUTO. When the P-P AUTO pushbutton is pressed, a triggered display is provided at any setting of the LEVEL/SLOPE control whenever an adequate trigger signal is applied. The range of the LEVEL/SLOPE control in this mode is between about 10% and 90% of the peak-to-peak amplitude of the applied trigger signal. The LEVEL/SLOPE control can be set so the displayed waveform starts at any point within this range on either slope. In the P-P AUTO mode, the trigger circuit automatically compensates for changes in trigger signal amplitude for signals above the minimum amplitude requirement. Therefore, if the LEVEL/SLOPE control is set so the displayed waveform starts at a certain percentage-point on the leading edge of a low-amplitude signal, it triggers at the same percentage-point on the leading edge of a high-amplitude signal if the LEVEL/SLOPE control is not changed. This operation is illustrated in Fig. 2-5.

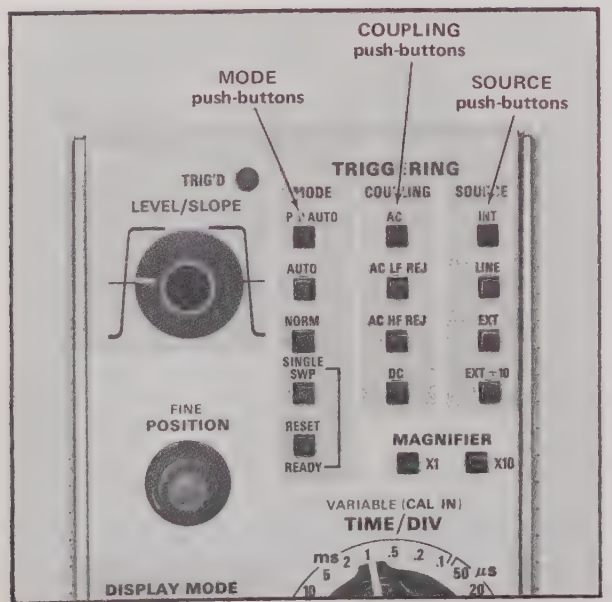


Fig. 2-4. Exploded view of front panel showing push-buttons associated with the MODE, COUPLING and SOURCE switches.

When the trigger repetition rate is below about 200 hertz (or outside the frequency range selected by the COUPLING switch), or when the trigger signal is inadequate, the sweep free runs at the sweep rate indicated by the TIME/DIV switch to produce a reference trace (TRIG'D light off). When an adequate trigger signal is again applied, the free-running condition ends and a triggered display is presented.

The P-P AUTO trigger mode is particularly useful when observing a series of waveforms, since it is not necessary to reset the LEVEL/SLOPE control for each observation. Also, because of the ease of obtaining a triggered display in this mode, the P-P AUTO trigger mode can be used for most applications and the remaining modes used only for special applications.

AUTO. When the AUTO push-button is illuminated, a triggered display is presented with the correct setting of the LEVEL/SLOPE control (see Trigger Level discussion) whenever an adequate trigger signal is applied. The range of the LEVEL/SLOPE control in this mode is ±8 vertical divisions. The TRIG'D light indicates when the display is triggered.

When the trigger repetition rate is below about 30 hertz (or outside the frequency range selected by the COUPLING switch) or when the trigger signal is inadequate, the sweep free runs at the sweep rate indicated by the TIME/DIV switch to produce a reference trace (TRIG'D light off). When an adequate trigger signal is again applied, the free-running condition ends and a triggered display is presented. When the LEVEL/SLOPE control is at a setting outside the amplitude range of the trigger signal, the sweep also free runs at the sweep rate indicated by the TIME/DIV switch. This type of free-running display can be useful when it is desired to measure only the maximum peak-to-peak amplitude of a signal without observing the waveshape (such as in bandwidth measurements).

NORM. When the NORM push-button is pressed, a triggered display is presented with the correct setting of the LEVEL/SLOPE control whenever an adequate trigger signal is applied. The range of the LEVEL/SLOPE control in this mode is ±8 vertical divisions. The TRIG'D light indicates when the display is triggered.

The NORM trigger mode must be used to produce triggered displays with trigger repetition rates below about 30 hertz. When the LEVEL/SLOPE control is at a setting outside the amplitude range of the trigger signal, when the

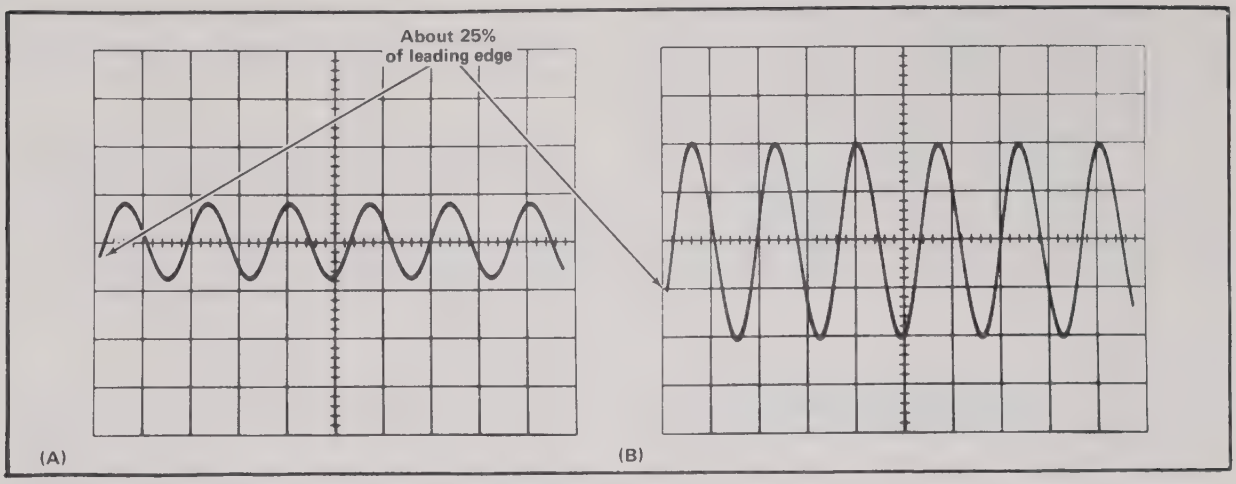


Fig. 2-5. LEVEL/SLOPE control operation for (P-P) AUTO mode triggering. (A) LEVEL/SLOPE control set so displayed waveform starts at about 25% point of a one-division waveform. (B) displayed waveform still triggered at about 25% of leading edge, when signal amplitude increases, to produce a four-division display (LEVEL/SLOPE control at same setting for both waveforms).

trigger repetition rate is outside the frequency range selected by the COUPLING switch or when the trigger signal is inadequate, there is no trace (TRIG'D light off).

SINGLE SWP. When the signal to be displayed is not repetitive or varies in amplitude, waveshape or repetition rate, a conventional repetitive type display may produce an unstable presentation. A stable display can often be obtained under these circumstances by using the single-sweep feature of this unit. The SINGLE SWP MODE is also useful to photograph non-repetitive or unstable displays.

To obtain a single-sweep display of a repetitive signal, first obtain the best possible display in the NORM MODE. Then without changing the other TRIGGERING controls, press the SINGLE SWP pushbutton. When ready to view the single-sweep display, press the RESET-READY pushbutton. A single trace is presented each time the RESET-READY pushbutton is pressed (as long as the repetitive signal remains connected to the system and TRIGGERING controls are correctly set) and further sweeps cannot be presented until the RESET-READY pushbutton is pressed again. If the displayed signal is a complex waveform composed of pulses of varying amplitude, successive single-sweep displays may not start at the same point of the waveform. To avoid confusion due to the CRT persistence, allow the display to decay before pressing the RESET-READY pushbutton again. At fast sweep rates, it may be difficult to view the single-sweep display. The apparent trace intensity can be increased by reducing the ambient light level or using a viewing hood as recommended in the indicator instruction manual.

Non-repetitive, random signals can be displayed in the single-sweep mode by first obtaining the best possible display in the NORM MODE with a signal which is about the same amplitude and frequency as the random signal. Then without changing the other TRIGGERING controls, press the SINGLE SWP pushbutton. When ready for the random signal, press the RESET-READY pushbutton. The RESET-READY pushbutton remains lighted to indicate that the unit has been reset and is ready to produce a sweep. The light goes out after the random signal triggers the unit. To prepare the unit for another single-sweep display, press the RESET-READY pushbutton again.

When using the single-sweep mode to photograph waveforms, the graticule must be photographed separately in the normal manner to prevent over-exposing the film. Be sure the camera system is well protected against stray light, or operate the system in a darkened room. For repetitive waveforms, press the RESET-READY pushbutton only once for each waveform unless the signal is completely symmetrical. Otherwise, multiple waveforms may appear on the film. For random signals, the camera lens can be left open until the random signal triggers the unit (RESET-READY pushbutton lighted). Further information on photographic techniques is given in the camera instruction manual.

Trigger Coupling

The pushbuttons located below the COUPLING title (see Fig. 2-4) select the method in which the trigger signal is connected to the trigger circuits. The selected coupling is

indicated by a lighted pushbutton. Each position permits selection or rejection of the frequency components of the trigger signal which trigger the sweep. Fig. 2-6 graphically illustrates the band of frequencies covered by each position of the COUPLING switch.

AC. In the AC position of the COUPLING switch, the DC component of the trigger signal is blocked. Signals with low-frequency components below about 30 hertz are attenuated. In general, AC COUPLING can be used for most applications. However, if the signal contains unwanted frequency components or if the sweep is to be triggered at a low repetition rate or DC level, one of the remaining COUPLING switch positions will provide a better display.

The triggering point in the AC position depends upon the average voltage level of the trigger signal. If the trigger signal occurs randomly, the average voltage level will vary, causing the triggering point to vary also. This shift of the triggering point may be enough so it is impossible to maintain a stable display. In such cases, use DC coupling.

AC LF REJ. In the AC LF REJ position, DC is rejected and low-frequency trigger signals below about 30 kilohertz are attenuated. Therefore, the sweep is triggered only by the higher-frequency components of the trigger signal. This position is particularly useful for providing stable triggering if the trigger signal contains line-frequency components. Also, the AC LF REJ position provides the best alternate-mode vertical displays at fast sweep rates when comparing two or more unrelated signals (with dual-trace vertical or slaved triggering operation for dual-vertical unit operation).

AC HF REJ. The AC HF REJ position passes all low-frequency signals between about 30 hertz and 50 kilohertz. DC is rejected and signals outside the above range are attenuated. When triggering from complex waveforms, this position is useful for providing stable display of the low-frequency components.

DC. DC COUPLING can be used to provide stable triggering with low-frequency signals which would be attenuated in the other modes, or with low-repetition rate signals. It can also be used to trigger the sweep when the trigger signal reaches a DC level selected by the setting of the LEVEL/SLOPE control. When using internal triggering, the setting of the vertical unit position controls affects the DC triggering point.

Trigger Source

The pushbuttons located below the SOURCE title (see Fig. 2-4) select the source of the trigger signal which is connected to the trigger circuits. The selected source is indicated by a lighted pushbutton.

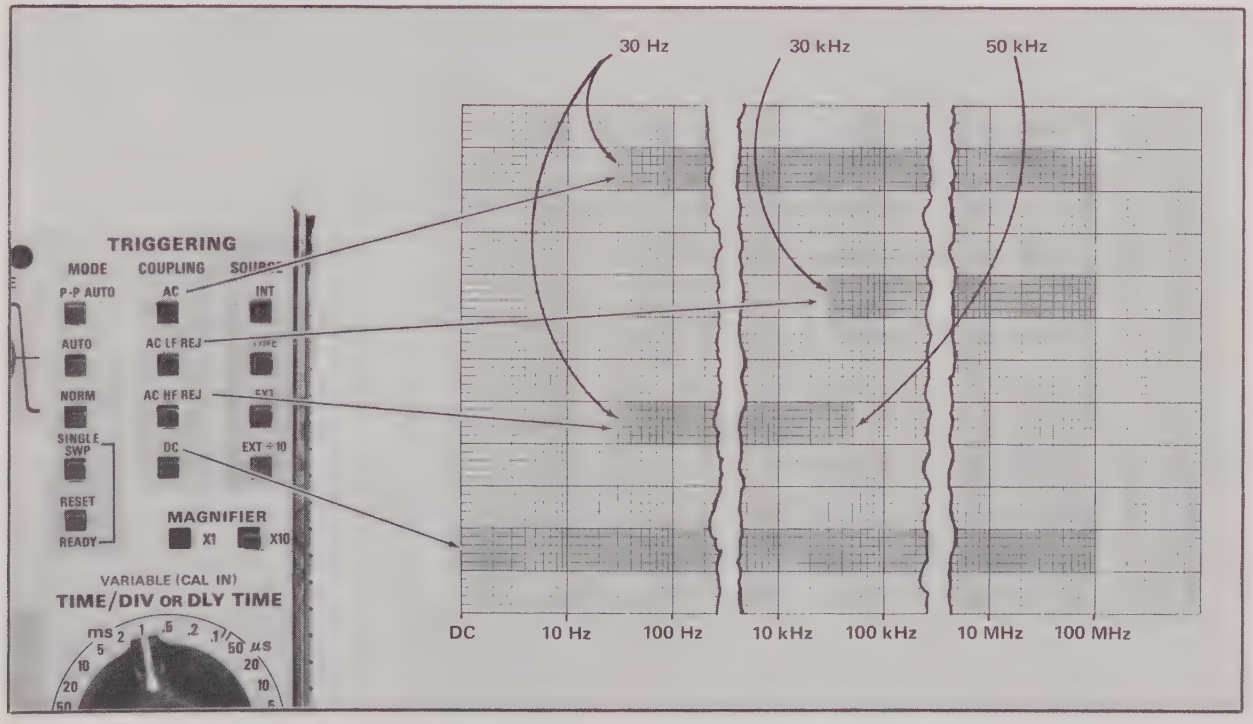


Fig. 2-6. Frequency range of each COUPLING switch position.

INT. In the INT position of the SOURCE switch, the trigger signal is derived from the associated vertical unit. Further selection of the internal trigger signal may be provided by the associated vertical unit or indicator oscilloscope; see the instruction manuals for these instruments for information. For most applications, the INT-SOURCE position can be used. However, some applications require special triggering which cannot be obtained in the INT-SOURCE position. In such cases LINE- or EXT-SOURCE must be used.

LINE. The LINE position of the SOURCE switch connects a sample of the power-line voltage, to which the indicator oscilloscope is connected, to the trigger circuit. Line triggering is useful when the input signal is time-related (multiple or sub-multiple) to the line frequency. It is also useful for providing a stable display of a line-frequency component in a complex waveform.

EXT. An external signal connected to the EXT TRIG IN connector can be used to trigger the sweep in the EXT-SOURCE position. The external signal must be time-related to the displayed waveform for a stable display. An external trigger signal can be used to provide a triggered display when the internal signal is too low in amplitude for correct triggering or contains signal components on which it is not desired to trigger. It is also useful when signal tracing in amplifiers, phase-shift networks, wave-shaping circuits, etc. The signal from a single point in the circuit under test can be connected to the EXT TRIG IN connector through a probe or cable. The sweep is then triggered by the same signal at all times and allows amplitude, time relationship or waveshape changes of signals at various points in the circuit to be examined without resetting the TRIGGERING controls.

EXT ÷ 10. Operation in the EXT ÷ 10 position is the same as described for EXT except that the external signal is attenuated 10 times. Attenuation of high-amplitude external trigger signals is desirable to broaden the range of the LEVEL/SLOPE control.

Trigger Slope

The LEVEL/SLOPE control determines whether the trigger circuit responds on the positive-going or negative-going portion of the trigger signal. When the indicator line on the outer ring of the LEVEL/SLOPE control is to the left of center, the display starts on the positive-going portion of the waveform (notice positive-going waveform to left of control. To the right of center, the display starts on the negative-going portion of the waveform (notice negative-going waveform). The effect of the LEVEL/SLOPE control on the displayed waveform is shown in Fig. 2-7. When several cycles of a signal appear in the display, the selection of the trigger slope is often unimportant. However, if only a certain portion of a cycle is to be displayed, correct setting of the LEVEL/SLOPE control is important to provide a display which starts on the desired slope of the input signal.

The LEVEL/SLOPE control determines the voltage level on the trigger signal at which the display is triggered, as well as selecting the trigger slope. The center knob of the LEVEL/SLOPE control provides about a 3:1 reduction in relation to the outer indicator ring, to allow precise level selection. This control can also be turned throughout the complete 360° rotation to allow continuous triggering over the selected slope. This is particularly useful in the P-P AUTO MODE. When the LEVEL/SLOPE control is set to the "0" on either the positive-going or negative-going waveform, the sweep is triggered near the zero-volt level of the trigger signal. As the LEVEL/SLOPE control is rotated away from the "0", the displayed waveform starts at a point corresponding to the position of the indicator line on the associated slope waveform (within amplitude range of trigger signal except in P-P AUTO MODE which provides triggered display throughout entire slope). For example, if the LEVEL/SLOPE control is turned clockwise from the "0" on the positive-going slope, the displayed waveform starts at a more positive level. Fig. 2-7 illustrates the operation of the LEVEL/SLOPE control at different levels and slopes of a displayed waveform.

Before setting the triggering level, select the TRIGGERING SLOPE, MODE, COUPLING and SOURCE. Then adjust the LEVEL/SLOPE control so the displayed waveform starts at the desired point. The triggering slope can be changed at any time by rotating the LEVEL/SLOPE control to the corresponding point on the other slope waveform.

Horizontal Sweep Rate

The TIME/DIV switch provides 25 calibrated sweep rates ranging from 0.05 microsecond/division to five seconds/division. The VARIABLE TIME/DIV control must be in the calibrated position and the MAGNIFIER at X1 for the indicated sweep rate. The VARIABLE TIME/DIV control incorporates a two-position switch to determine if the sweep rate is calibrated or uncalibrated. When the VARIABLE knob is in the inward position, the VARIABLE TIME/DIV control is inoperative and the sweep rate is calibrated. When pressed and released, the VARIABLE knob moves outward to activate the VARIABLE TIME/DIV control for uncalibrated sweep rates. A calibrated sweep rate can be obtained at any position of the VARIABLE TIME/DIV control by pressing in the VARIABLE knob. This feature is useful when a specific uncalibrated sweep rate has been obtained and it is desired to switch between this uncalibrated sweep rate and a calibrated sweep rate. Switching from uncalibrated to calibrated operation or vice versa does not affect the setting of the VARIABLE TIME/DIV control. The VARIABLE TIME/DIV control

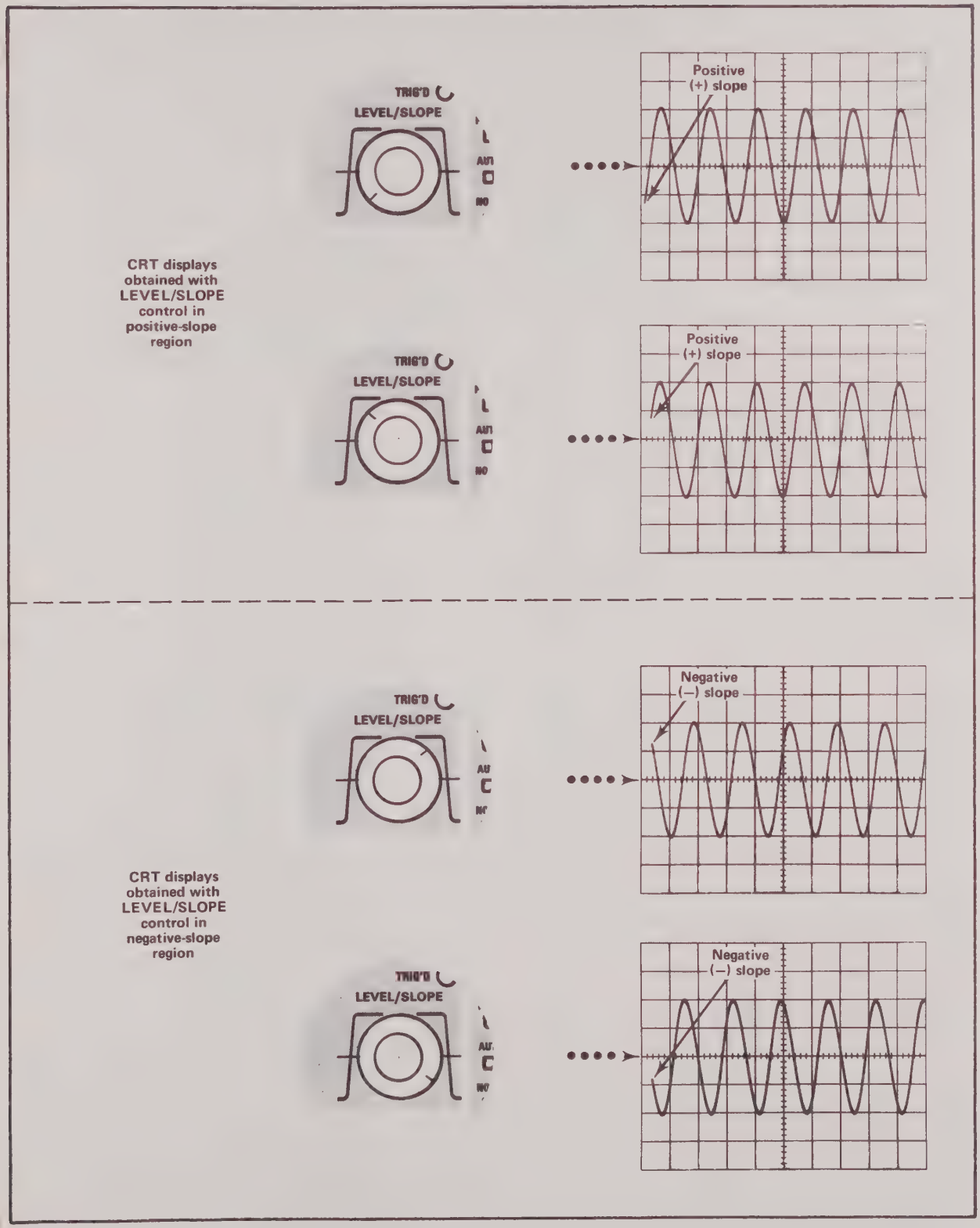


Fig. 2-7. Effect of LEVEL/SLOPE control on CRT display (AUTO P-P MODE).

allows the sweep rate in each TIME/DIV switch position to be reduced to at least the sweep rate of the next adjacent switch position. This provides an overall uncalibrated variable sweep rate range from 50 nanoseconds/division (from 5 nanoseconds/division with MAGNIFIER at X10) to about 12.5 seconds/division.

When making time measurements from the graticule, the area between the second-division and tenth-division vertical lines of the graticule provides the most linear time measurement (see Fig. 2-8). Therefore, the first and last division of the display area should not be used when making accurate time measurements. Position the start of the timing area to the second-division vertical line (second line from the left) and adjust the TIME/DIV switch so the end of the timing area falls between the second-division and tenth-division vertical lines.

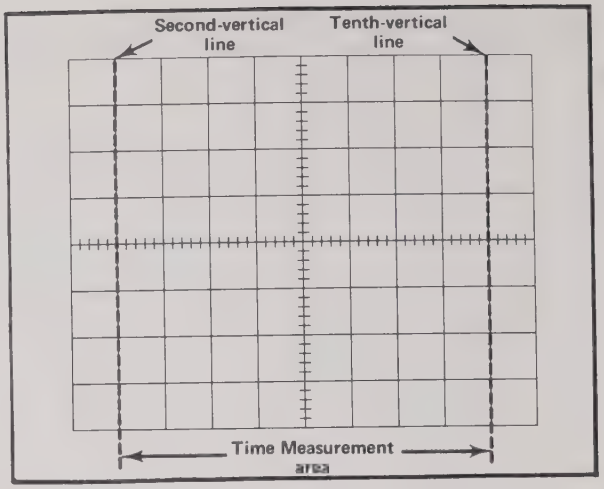


Fig. 2-8. Area of graticule used for accurate time measurements.

Sweep Magnifier

The sweep magnifier expands the sweep ten times. The center division of the unmagnified display is the portion visible on the screen in magnified form (see Fig. 2-9). Equivalent length of the magnified sweep is more than 100 divisions; any 10-division portion can be viewed by adjusting the horizontal POSITION control to bring the desired portion onto the viewing area. The dual-range feature of the horizontal POSITION control is particularly useful when the MAGNIFIER is set to X10 (see Horizontal Position Control discussion which follows).

To use sweep magnification, first move the portion of the display which is to be expanded to the center of the graticule. Then press the X10-MAGNIFIER pushbutton; the X10 button lights to indicate that the horizontal sweep rate is magnified. Whenever the X10-MAGNIFIER pushbutton is lighted, the equivalent magnified sweep rate can be determined by dividing the TIME/DIV switch setting by 10. For example, if the TIME/DIV switch is set to .05 µs, the equivalent magnified sweep rate is 5 nanoseconds/division. The equivalent magnified sweep rate must be used for all time measurements when the X10-MAGNIFIER button is lighted. The equivalent magnified sweep rate is calibrated when the VARIABLE TIME/DIV control is in the calibrated position.

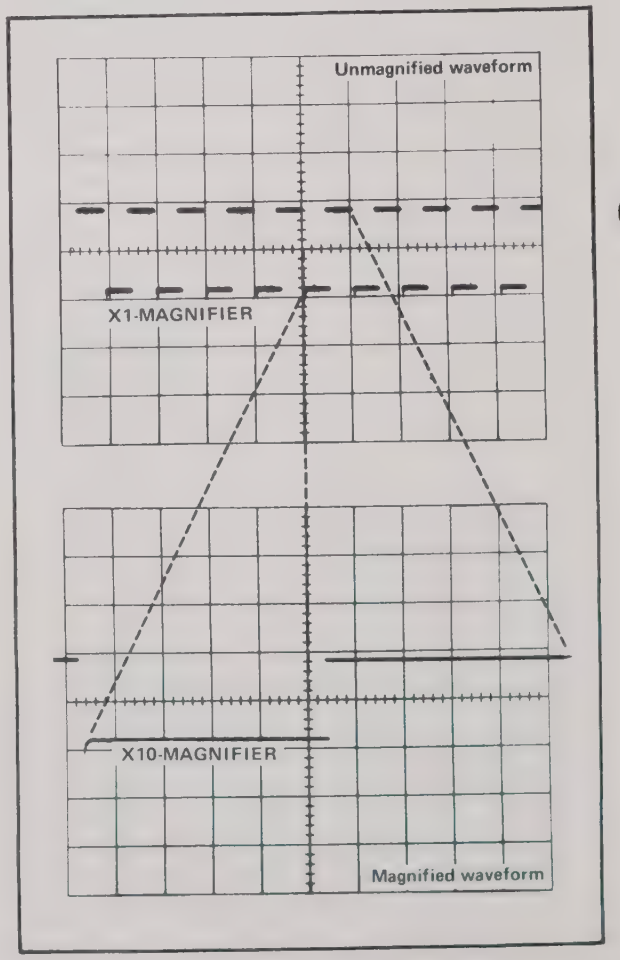


Fig. 2-9. Operation of sweep magnifier.

Horizontal Position Control

The Type 7B50 provides both fine and coarse adjustment of positioning. The coarse adjustment provides rapid horizontal positioning of the trace. Fine positioning is provided for more precise control of trace position.

Display Mode

Time-Base. With the DISPLAY MODE switch in the TIME BASE position the Type 7B50 functions as a normal time-base with the sweep rate set by the TIME/DIV switch.

Amplifier. In some applications, it is desireable to display one signal versus another (X-Y) rather than against time. The AMPLIFIER position of the DISPLAY MODE switch provides a means for applying an external signal to the horizontal amplifier for this type of display. The correct COUPLING and SOURCE must be selected to correspond to the signal applied to the EXT VOLTS IN connector.

Two modes of external horizontal operation are provided. When the SOURCE switch is set to INT, the horizontal deflection is provided by a signal applied to the vertical amplifier. In the EXT and EXT ÷ 10 positions of the SOURCE switch, external horizontal deflection is provided by the signal applied to the EXT VOLTS IN connector. The signal coupling provided by the COUPLING switch can be used to select or reject components of the external horizontal signal.

The external horizontal deflection factor (with Amplifier VARIABLE fully clockwise) is approximately 90 millivolts per division in the EXT position of the SOURCE switch and approximately 900 millivolts per division in the EXT ÷ 10 position of the SOURCE switch.

APPLICATIONS

General

The following information describes the procedures and techniques for making basic measurements with a Tektronix Type 7500-series Oscilloscope. These applications are not described in detail, since each application must be adapted to the requirements of the individual measurement. This instrument can also be used for many applications not described in this manual. Contact your local Tektronix Field Office or representative for assistance in making specific measurements. Also, the following books describe oscilloscope measurement techniques which can be adapted for use with this instrument:

Harley Carter, "An Introduction to the Cathode Ray Oscilloscope", Philips Technical Library, Cleaver-Hume Press Ltd., London, 1960.

J. Czech, "Oscilloscope Measuring Technique", Philips Technical Library, Springer-Verlag, New York, 1965.

Robert G. Middleton and L. Donald Payne, "Using the Oscilloscope in Industrial Electronics", Howard W. Sams & Co. Inc., The Bobbs-Merrill Company Inc., Indianapolis, 1961.

John F. Rider and Seymour D. Uslan, "Encyclopedia of Cathode-Ray Oscilloscopes and Their Uses", John F. Rider Publisher Inc., New York, 1959.

John F. Rider, "Obtaining and Interpreting Test Scope Traces", John F. Rider Publisher Inc., New York, 1959.

Rufus P. Turner, "Practical Oscilloscope Handbook", Volumes 1 and 2, John F. Rider Publisher Inc., New York, 1964.

Frequency Comparison

Sweep Rates. To establish an arbitrary horizontal sweep rate based upon a specific reference frequency, proceed as follows:

1. Connect the reference signal to the INPUT connector. Set the VOLTS/DIV switch for four or five divisions of vertical deflection.

2. Set the TIME/DIV switch and the VARIABLE TIME/DIV control so one cycle of the signal covers an exact number of horizontal divisions. Do not change the VARIABLE TIME/DIV control after obtaining the desired deflection. This display can be used as a reference for frequency comparison measurements.

3. To establish an arbitrary sweep rate so the repetition rate of an unknown signal can be measured accurately at any setting of the TIME/DIV switch, the repetition rate of the reference signal must be known. If it is not known, it can be measured before the VARIABLE TIME/DIV switch is set in step 2.

4. Divide the repetition rate of the reference signal (seconds) by the product of the horizontal deflection established in step 2 (divisions) and the setting of the TIME/DIV switch. This is the horizontal conversion factor:

$$\text{Horizontal Conversion Factor} = \frac{\text{reference signal repetition rate (seconds)}}{\text{horizontal deflection (divisions)} \times \text{TIME/DIV switch setting}}$$

5. To measure the repetition rate of an unknown signal, disconnect the reference signal and connect the unknown signal to the INPUT connector. Set the TIME/DIV switch to a setting that provides sufficient horizontal deflection to make an accurate measurement. Do not readjust the VARIABLE TIME/DIV control.

6. Measure the horizontal deflection in divisions and calculate the repetition rate of the unknown signal using the following formula:

$$\text{Repetition Rate} = \text{TIME/DIV switch setting} \times \text{horizontal conversion factor} \times \text{horizontal deflection (divisions)}$$

NOTE

If the horizontal magnifier is used, be sure to use the magnified sweep rate in place of the TIME/DIV switch setting.

Example. Assume a reference signal frequency of 455 hertz (repetition rate 2.19 milliseconds), a TIME/DIV switch setting of .2 ms, and the VARIABLE TIME/DIV control adjusted to provide a horizontal deflection of eight divisions. Substituting these values in the horizontal conversion factor formula (step 4):

$$\text{Horizontal Conversion Factor} = \frac{2.19 \text{ milliseconds}}{.2 \times 8} = 1.37$$

Then, with a TIME/DIV switch setting of 50 µs, the repetition rate of an unknown signal which completes one cycle in seven horizontal divisions can be determined by using the repetition rate formula (step 6):

$$\text{Repetition Rate} = 50\ \mu s \times 1.37 \times 7 = 480\ \mu s$$

This answer can be converted to frequency by taking the reciprocal of the repetition rate (see application on Determining Frequency Measurements).

Time-Duration Measurements

To measure time between two points on a waveform, use the following procedure:

1. Connect the signal to either Vertical plug-in.

2. Set the MODE switch to display the plug-in used.

3. Set the VOLTS/DIV switch to display about four divisions of the waveform.

4. Set the Type 7B50 triggering controls to obtain a stable display.

5. Set the TIME/DIV switch to the fastest sweep rate that displays less than eight divisions between the time measurement points (see Fig. 2-8). (See the topic entitled Horizontal Sweep Rate in this section concerning non-linearity of first and last divisions of a display.)

6. Adjust the vertical POSITION control to move the points between which the time measurement is made to the center horizontal reference line.

7. Adjust the horizontal POSITION control to position the time-measurement points within the center eight divisions of the graticule.

8. Measure the horizontal distance between the time measurement points. Be sure the A VARIABLE control is set to CAL.

9. Multiply the distance measured in step 8 by the setting of the TIME/DIV switch. If sweep magnification is used, divide this answer by 10.

Example. Assume that the distance between the time measurement points is five divisions (see Fig. 2-10), and the TIME/DIV switch is set to .1 ms with the magnifier to X1. Using the formula:

$$\text{Time Duration} = \frac{\text{horizontal distance (divisions)} \times \text{TIME/DIV setting}}{\text{magnification}}$$

Substituting the given values:

$$\text{Time Duration} = \frac{5 \times 0.1 \text{ ms}}{1}$$

The time duration is 0.5 milliseconds.

Determining Frequency

The time measurement technique can also be used to determine the frequency of a signal. The frequency of a periodically recurrent signal is the reciprocal of the time duration (period) of one complete cycle.

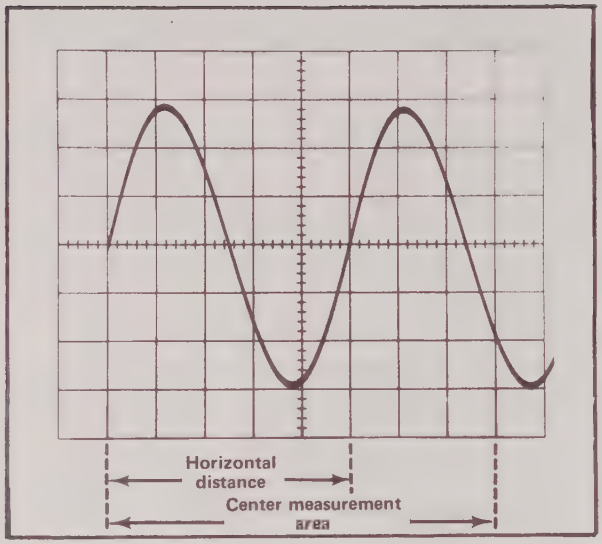


Fig. 2-10. Measuring the time duration between points on a waveform.

Use the following procedure:

1. Measure the time duration of one complete cycle of the waveform as described in the previous application.

2. Take the reciprocal of the time duration to determine the frequency.

Example. The frequency of the signal shown in Fig. 2-10 which has a time duration of 0.5 milliseconds is:

$$\text{Frequency} = \frac{1}{\text{time duration}} = \frac{1}{0.5\text{ ms}} = 2\text{ kilohertz}$$

Risetime Measurements

Risetime measurements employ basically the same techniques as time-duration measurements. The main difference is the points between which the measurement is made. The following procedure gives the basic method of measuring risetime between the 10% and 90% points of the waveform. Falltime can be measured in the same manner on the trailing edge of the waveform.

1. Connect the signal to either Vertical plug-in.

2. Set the MODE switch to display the plug-in used.

3. Set the VOLTS/DIV switch and the VARIABLE control to produce a signal an exact number of divisions in amplitude.

4. Center the display about the center horizontal line with the vertical POSITION control.

5. Set the Triggering control to obtain a stable display.

6. Set the TIME/DIV switch to the fastest sweep rate that displays less than eight divisions between the 10% and 90% points on the waveform.

7. Determine the 10% and 90% points on the rising portion of the waveform. The figures given in Table 2-1 are for the points 10% up from the start of the rising portion and 10% from the top of the rising portion (90% point).

TABLE 2-1

Vertical display (divisions)	10% and 90% points	Divisions vertically between 10% and 90% points
4	0.4 and 3.6 divisions	3.2
5	0.5 and 4.5 divisions	4.0
6	0.6 and 5.4 divisions	4.8

8. Adjust the horizontal POSITION control to move the 10% point of the waveform to the center measurement area. For example, with a five-division display as shown in Fig. 2-11, the 10% point is 0.5 division up from the start of the rising portion.

9. Measure the horizontal distance between the 10% and 90% points. Be sure the A VARIABLE control is set to CAL.

10. Multiply the distance measured in step 9 by the setting of the TIME/DIV switch. If sweep magnification is used, divide this answer by 10.

Example. Assume that the horizontal distance between the 10% and 90% points is three divisions (see Fig. 2-11) and the TIME/DIV switch is set to 1 μs with the MAG switch set to X10. Applying the time duration formula to risetime:

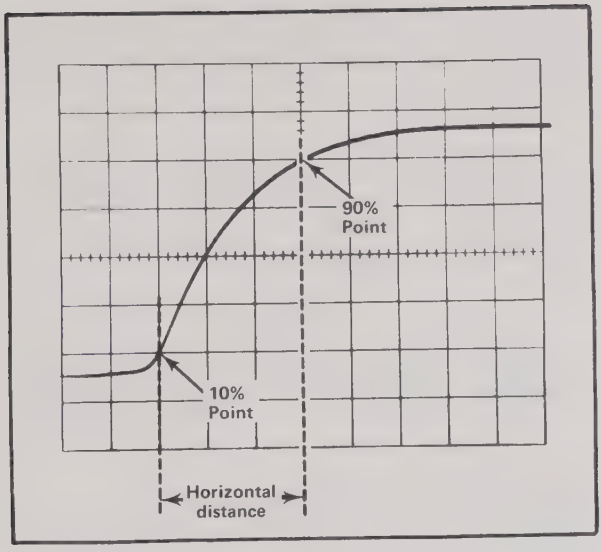


Fig. 2-11. Measuring risetime.

$$\text{Time Duration (Risetime)} = \frac{\text{horizontal distance (divisions)} \times \text{TIME/DIV setting}}{\text{magnification}}$$

Substituting the given values:

$$\text{Risetime} = \frac{3 \times 1\ \mu s}{10}$$

The risetime is 0.3 microsecond.

Delayed Sweep Time Measurements

The delayed sweep mode can be used to make accurate time measurements. The following measurement determines the time difference between two pulses displayed on the same trace. This application may also be used to measure time difference from two different sources (dual-trace) or to measure time duration of a single pulse. See Section one for measurement accuracy.

1. Connect the signal to either vertical plug-in. Set the Indicator Oscilloscope vertical MODE selector to display the plug-in being used. Set the horizontal MODE selector to CHOP or ALT (see Oscilloscope Manual discussion on horizontal mode switching) to display both Time-Base sweeps.

2. Set the VOLTS/DIV selector to produce a display about three divisions in amplitude (see Fig. 2-12).

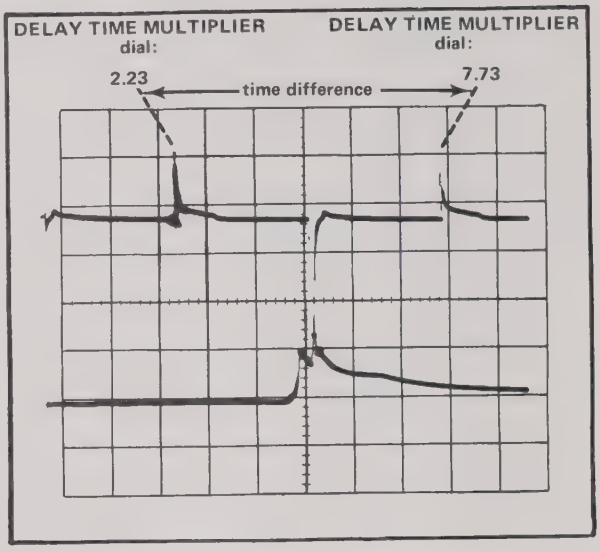


Fig. 2-12. Measuring time difference using delayed sweep.

3. Set the A TIME/DIV to a sweep rate which displays about six divisions between pulses. Adjust the A Triggering controls for a stable display.

4. Set the A Time-Base B DELAY MODE selector to B STARTS AFTER DELAY.

5. Set the Type 7B50 (B) TIME/DIV to a setting 1/100 of the A TIME/DIV sweep rate. This produces an intensified portion about 0.1 division in length.

NOTE

Do not change the A LEVEL control setting or the horizontal POSITION control setting in the following steps, as the measurement accuracy will be affected.

6. Turn the DELAY-TIME MULTIPLIER dial to move the intensified portion of the A sweep to the first pulse.

7. Adjust the DELAY-TIME MULTIPLIER dial to move the pulse (or rising portion) of the B sweep to the center vertical line. Note the setting of the DELAY-TIME MULTIPLIER dial.

8. Turn the DELAY-TIME MULTIPLIER dial clockwise until the second pulse is positioned to this same point (if

several pulses are displayed, observe the intensified portion of the A sweep to locate the correct pulse). Again note the dial setting.

9. Subtract the first dial setting from the second and multiply by the delay time shown by the A TIME/DIV selector. This is the time interval between the pulses.

Example: Assume the first dial setting is 2.23 and the second dial setting is 7.73 with the TIME/DIV set to 5 μs (see Fig. 2-12).

Using the formula:

$$\text{Time Difference (delayed sweep)} = (\text{second dial setting} - \text{first dial setting}) \times (\text{delay time (A TIME/DIV setting)})$$

Substituting the given values:

$$\text{Time Difference} = (7.73 - 2.23) \times 5\ \mu s.$$

The time difference is 27.5 microseconds.

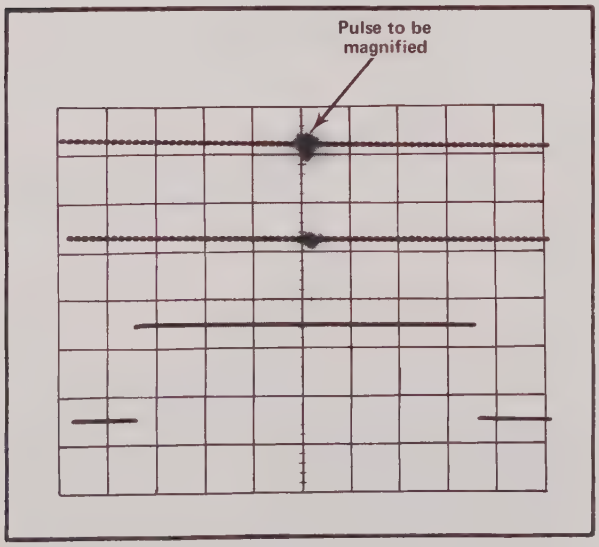


Fig. 2-13. Using delayed sweep for sweep magnification.

Delayed Sweep Magnification

The delayed sweep feature can be used to provide higher apparent magnification than is provided by the MAG switch. The sweep rate of the DELAYED SWEEP (Type 7B50) is not actually increased; the apparent magnification is the result of delaying the B sweep an amount of time selected by the A TIME/DIV switch and the DELAY-TIME MULTIPLIER dial before the display is presented at the sweep rate selected by the B TIME/DIV switch. The following method uses the B STARTS AFTER DELAY position to allow the delayed portion to be positioned with the DELAY-TIME MULTIPLIER dial. If there is too much jitter in the delayed display, use the Triggered Delayed Sweep Magnification procedure.

1. Connect the signal to either vertical plug-in. Set the Indicator Oscilloscope vertical MODE selector to display the plug-in used and the horizontal MODE to CHOP or ALT to display both Time-Base sweeps.

2. Set the VOLTS/DIV selector to produce a display about three divisions in amplitude.

3. Set the A Time-Base B DELAY MODE selector to B STARTS AFTER DELAY. Adjust the A Triggering controls for a stable display.

4. Set the A TIME/DIV to a sweep rate which displays the complete waveform.

5. Position the start of the intensified portion with the DELAY-TIME MULTIPLIER dial to the part of the display to be magnified.

6. Set the Type 7B50 TIME/DIV to a setting which intensifies the full portion to be magnified. The start of the intensified trace remains as positioned above.

7. Time measurements can be made from the display in the conventional manner. Sweep rate is determined by the setting of the Type 7B50 TIME/DIV selector.

Example: The apparent magnification of the display shown in Fig. 2-13 with an A TIME/DIV setting of .1 ms and a B TIME/DIV setting of 1 μs is:

$$\text{Apparent Magnification (Delayed Sweep)} = \frac{\text{A TIME/DIV setting}}{\text{B TIME/DIV setting}}$$

Substituting the given values:

$$\text{Apparent Magnification} = \frac{1 \times 10^{-4}}{1 \times 10^{-6}} = 100$$

The apparent magnification is 100 times.

Triggered Delayed Sweep Magnification. The delayed sweep magnification method just described may produce too much jitter at high apparent magnification ranges. The B TRIGGERABLE AFTER DELAY position of the A Time-Base B DELAY MODE selector provides a more stable display, since the delayed display is triggered at the same point each time.

1. Set up the display as given in steps 1 through 6 above.

2. Set the B DELAY MODE selector to B TRIGGERABLE AFTER DELAY.

3. Adjust the B LEVEL SLOPE control so the intensified portion on the trace is stable.

4. Inability to intensify the desired portion indicates that the Type 7B50 Triggering controls are incorrectly set or the signal does not meet the triggering requirements. If the condition cannot be remedied with the B Triggering controls or by increasing the display amplitude (lower VOLTS/DIV setting), trigger the B sweep externally.

5. Measurement and magnification are as described above.

Displaying Complex Signals Using Delayed Sweep

Complex signals often consist of a number of individual events of differing amplitudes. Since the trigger circuits are sensitive to changes in signal amplitude, a stable display can normally be obtained only when the sweep is triggered by the event(s) having the greatest amplitude. However, this may not produce the desired display of a lower-amplitude portion which follows the triggering event. The delayed sweep feature provides a means of delaying the start of the B sweep by a selected amount following the event which triggers the A Sweep. Then, the part of the waveform which contains the information of interest can be displayed.

Use the following procedure:

1. Set up the display as given in Delayed Sweep Magnification Steps 1 through 6.

2. Time measurements can be made from the display in the conventional manner. Sweep rate is determined by the setting of the Type 7B50 TIME/DIV selector.

Example. Fig. 2-14 shows a complex waveform as displayed on the CRT. The intensified portion of the waveform cannot be viewed in any greater detail because the sweep is triggered by the larger amplitude pulses at the start of the display and a faster sweep rate moves this area of the waveform off the viewing area. The second waveform shows the area of interest magnified 10 times using Delayed Sweep. The DELAY-TIME MULTIPLIER dial has been adjusted so the delayed sweep starts just before the area of interest.

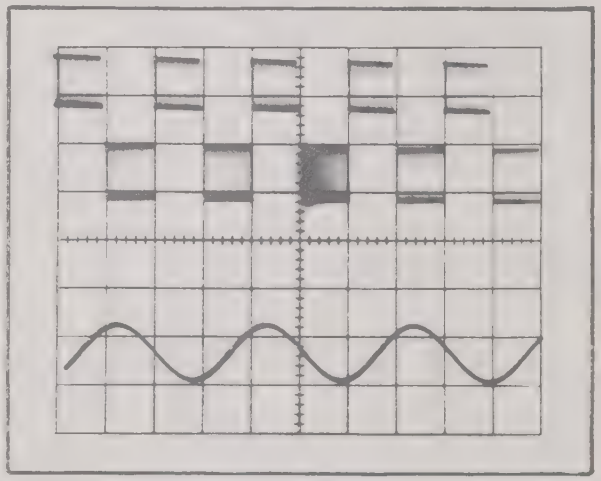


Fig. 2-14. Displaying a complex signal using delayed sweep.

Pulse Jitter Measurements

In some applications it is necessary to measure the amount of jitter on the leading edge of a pulse or jitter between pulses.

1. Set up the display as in the above procedure.

2. Set the B DELAY MODE selector to B STARTS AFTER DELAY. Slight readjustment of the B Triggering LEVEL control may be necessary to produce as stable a display as possible.

3. Pulse jitter is shown by horizontal movement on the pulse (take into account inherent jitter of Delayed Sweep).

Measure the amount of horizontal movement. Be sure both VARIABLE TIME/DIV controls are set to CAL.

4. Multiply the distance measured in step 3 by the B TIME/DIV switch setting to obtain pulse jitter in time.

Example. Assume that the horizontal movement is 0.5 divisions (see Fig. 2-15), and the B TIME/DIV switch setting is .5 µs.

Using the formula:

$$\text{Pulse Jitter} = \text{horizontal jitter (divisions)} \times \text{B TIME/DIV setting}$$

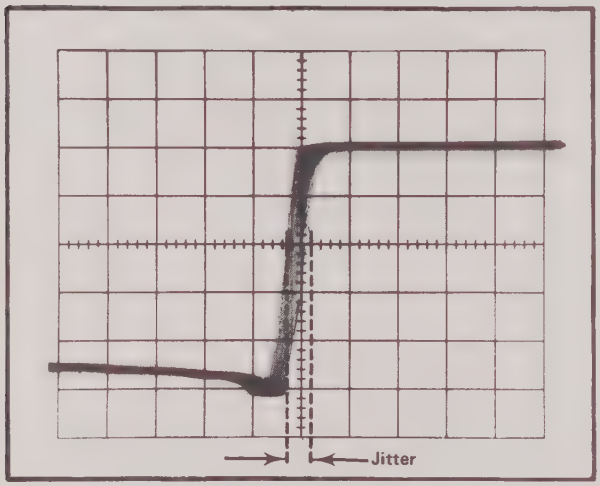


Fig. 2-15. Measuring pulse jitter.

Substituting the given values:

$$\text{Pulse Jitter} = 0.5 \times 0.5\ \mu s$$

The pulse jitter is 0.25 microseconds.

X-Y Phase Measurements

The X-Y phase measurement method can be used to measure the phase difference between two signals of the same frequency. In this mode, one of the sine-wave signals provides horizontal deflection (X) while the other signal provides the vertical deflection (Y). The phase angle between the two signals can be determined from the lissajous pattern as follows:

1. Place one Type 7B50 in the horizontal compartment and another Type 7B50 (or a vertical unit) in the vertical compartment of the oscilloscope.

2. Set both Type 7B50 controls as follows:

DISPLAY MODE	AMPLIFIER
COUPLING	AC
SOURCE	EXT

3. Connect the same signal to both EXT VOLTS IN connectors. Use the Amplifier VARIABLE controls to obtain a display less than 8 divisions vertically and less than 10 divisions horizontally. Measure and record the inherent phase shift for the oscilloscope system being used. See Fig. 2-16.

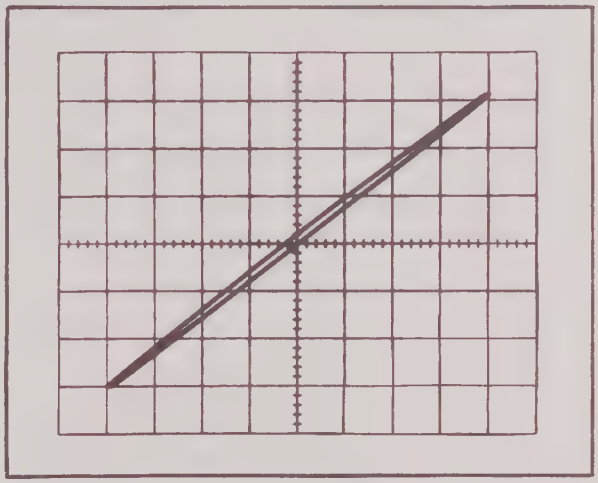


Fig. 2-16. X-4 display showing phase shift.

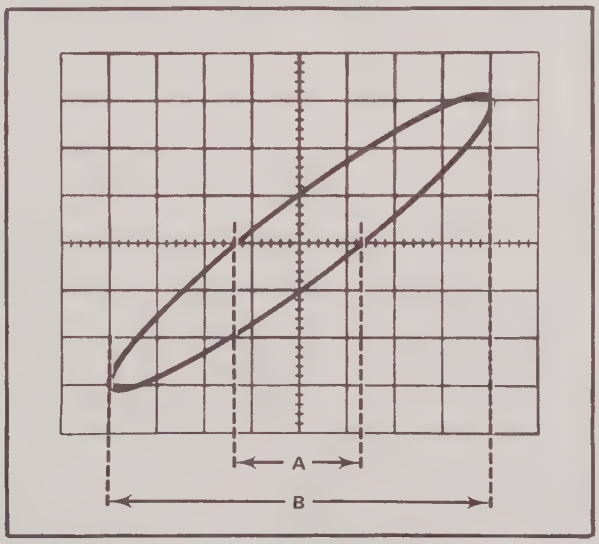


Fig. 2-17. Phase-difference measurement from an X-Y display.

4. Connect the Y signal to the Type 7B50 in the vertical compartment and the X signal to the Type 7B50 in the horizontal compartment.

5. Center the display in relation to the vertical graticule line. Measure the distances A and B as shown in Fig. 2-17. Distance A is the horizontal measurement between the two points where the trace crosses the center horizontal reference line. Distance B is the horizontal width of the display.

6. Divide A by B to obtain the sine of the phase angle between the two signals. Obtain the phase angle from a trigonometric table and subtract the inherent phase shift to obtain the actual phase difference.

Example. The phase angle shown in Fig. 2-16 is approximately 2° and in Fig. 2-17 the phase angle is 18°.

Measured Phase Angle		Inherent Phase Shift		Actual Phase Angle
18°	—	2°	=	16°

SECTION 3
CIRCUIT DESCRIPTION

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section of the manual contains a description of the circuitry used in the Type 7B50. The description begins with a discussion of the instrument using the basic block diagram shown in Fig. 3-1. Then each circuit is described in detail, using a detailed block diagram to show the interconnections between the stages in each major circuit, and the relationship of the front-panel controls to the individual stages.

A complete block diagram is located in the Diagrams Section at the back of this manual. This diagram shows the overall relationship between all of the circuits. Complete schematics of each circuit are also given in the Diagrams Section. Refer to these diagrams throughout the following circuit description for electrical values and relationship.

BLOCK DIAGRAM

General

The following discussion is provided to aid in understanding the overall concept of the Type 7B50 before the individual circuits are discussed in detail. A basic block diagram of the Type 7B50 is shown in Fig. 3-1. Each block represents a major circuit within this instrument.

The Trigger Preamp circuit provides amplification for the internal trigger signal. The internal trigger signal is received from the Vertical Deflection System. The output from this circuit is connected to the Trigger Generator circuit.

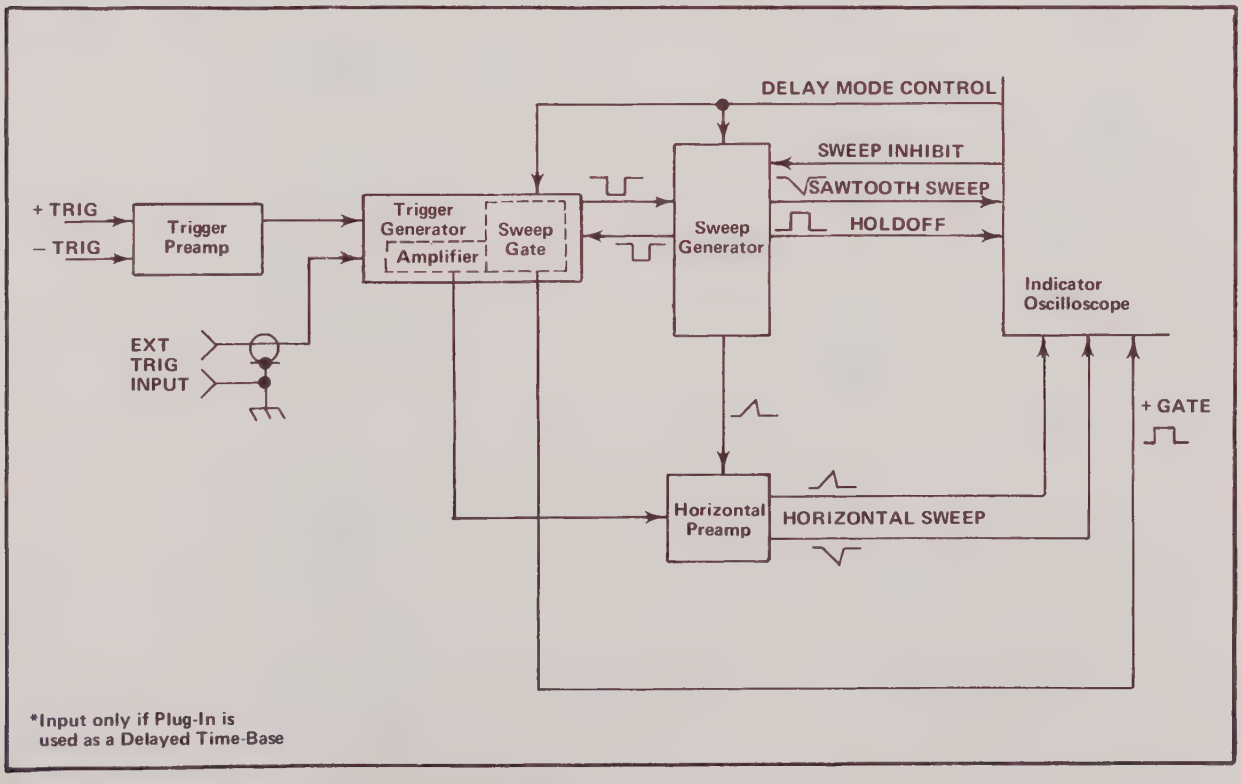


Fig. 3-1. Basic Block Diagram of the Type 7B50.

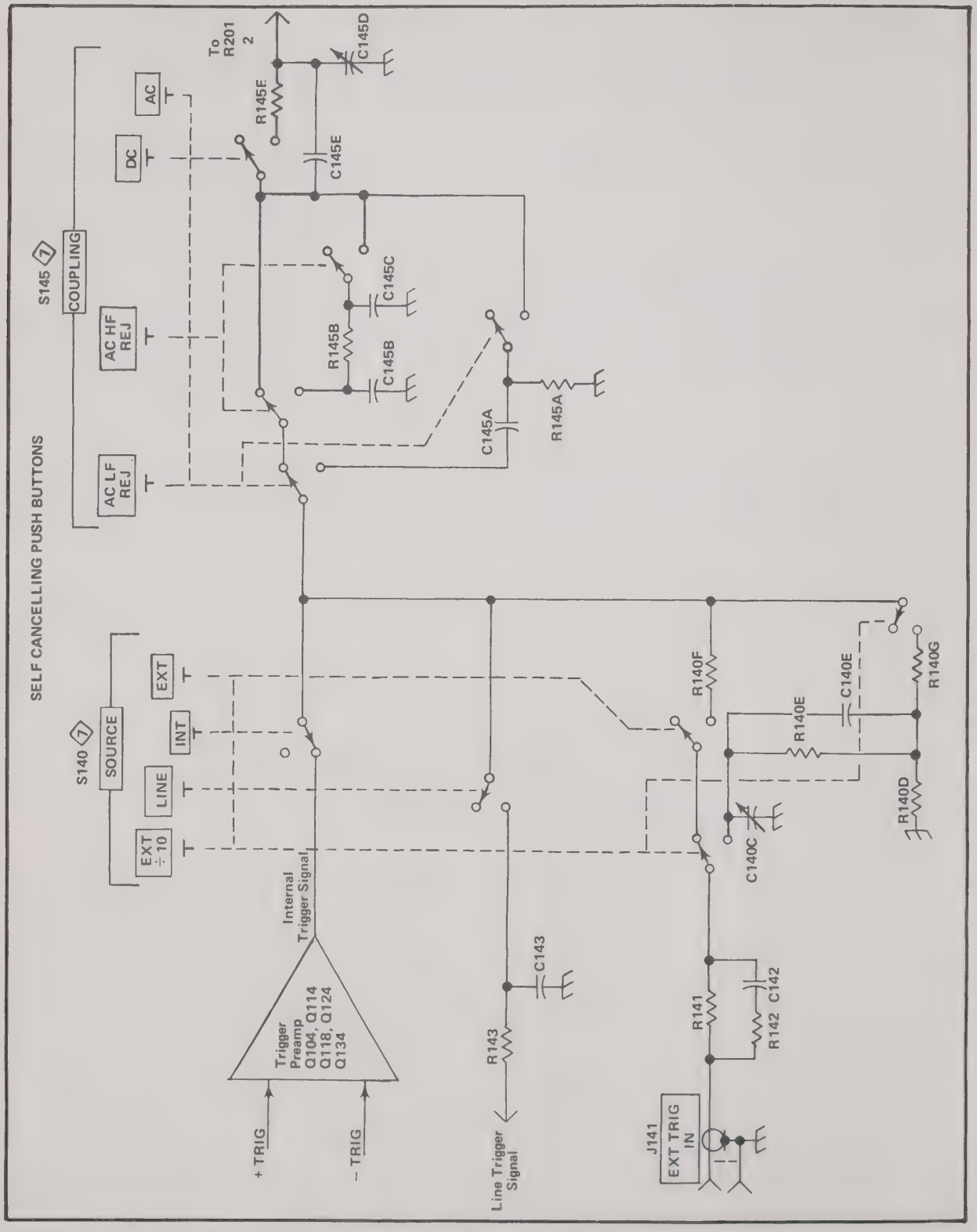


Fig. 3-2. Trigger Preamp and Input Switching Block Diagram.

The Trigger Generator circuits produce an output pulse which initiates the sweep signal produced by the Sweep Generator circuits. It also produces a + Gate for use by the Indicator Oscilloscope. The input signal to the Trigger Generator can be individually selected from among the following: the internal trigger signal from the Trigger Preamp, an external signal applied to the EXT TRIG INPUT connector, or a sample of the line voltage applied to the instrument. Each trigger circuit contains coupling and source controls.

The Sweep Generator circuit produces a linear sawtooth output signal when initiated by the Trigger Generator circuit. The slope of the sawtooth produced by the Sweep Generator is controlled by the TIME/DIV switch. The operating mode of the Sweep Generator is controlled by the TRIGGERING MODE switch. In the P-P AUTO and AUTO positions, the absence of an adequate trigger signal causes the sweep to free run. In the NORM position, a horizontal sweep is presented only when correctly triggered by an adequate trigger signal. The SINGLE SWEEP position allows only one sweep to be initiated after the circuit is reset with the RESET button.

The Horizontal Preamp is a single-ended to push-pull amplifier. It uses feedback (operational) amplifiers to achieve a great degree of stability. A X10 gain feature is incorporated into this amplifier. The sawtooth signal is received from the Sweep Generator circuit and changed to a push-pull output for use by the Indicator Oscilloscope to produce the horizontal display.

DETAILED CIRCUIT DESCRIPTION

Trigger Preamp and Input Switching

Trigger Preamp. The pushpull trigger signal from the Vertical Deflection System is converted to a single-ended output by the emitter-coupled stage, Q104-Q114. The output of Q114 drives current gain stage Q124-Q134. The DC level of the output is set by Internal Trigger Centering control, R135.

Input Switching. The TRIGGERING SOURCE switch, S140, selects the source of the trigger signal. Three trigger sources are available; internal, line and external. The external signal may also be passed through a ÷ 10 attenuator network.

The TRIGGERING COUPLING switch, S145, offers a means of attenuating high or low frequency components of the trigger signal. In addition to AC and DC coupling, C145A-R145A can be selected to provide low-frequency attenuation and R145B-C145B-C145C for high-frequency attenuation.

Trigger Generator

General. The Trigger Generator circuit produces trigger pulses to start the Sweep Generator circuit. These pulses are derived from either the internal trigger signal from the Vertical Deflection System, an external source, or from a sample of the line voltage applied to the instrument. Controls are provided in this circuit to select trigger LEVEL and SLOPE, and TRIGGERING MODE. Fig. 3-3 shows a detailed block diagram of the Trigger Generator circuit. Refer to the diagrams in Section 7 for complete circuit components.

Input Stage. The input source-follower, Q213A, provides a high input impedance for the trigger signal. It also provides isolation between the Trigger Generator and the input source. Input protection diodes, CR203 and CR206 protect Q213A from excessive input signals by clamping the gate of the input FET if the input exceeds about + or −6 volts. The signal at the source of Q213A is passed through emitter-follower Q214 to the base of Q224 in the Slope Comparator, and to the P-P Auto Trigger Level circuit.

P-P Auto Trigger Level Stage. The triggering level, with the MODE switch set to P-P AUTO, is controlled by the P-P Auto Trigger Level stage. The trigger input signal is applied through emitter-follower Q333, to reduce loading of the signal input stage. The signal is applied simultaneously to the bases of Q353 and Q373.

Assume a + input signal. This signal, coupled through emitter followers Q353-Q356, causes the emitter voltage to rise and charges C358 to the peak positive level of the input signal. C378 is charged in a similar manner to the peak negative level of the input signal. The peak-sensing capacitors, C358-C378, set the voltage levels applied to the LEVEL control (R260A). This allows the LEVEL control to be adjusted between the two voltage levels representing the most negative and most positive peaks of the trigger signal. The unit can be triggered at all positions of the LEVEL control if the minimum frequency and amplitude specifications are met. Q366-CR366 and Q386-CR386 provide temperature compensation for Q364 and Q384 respectively.

Slope Comparator. Q224 and Q234 are connected as a difference amplifier to provide selection of the slope and level at which the sweep is triggered. The reference voltage for the comparator (with the MODE selector at NORM) is provided by the LEVEL control, R260A, and the Level Center control, R385. R385 sets the level at the base of Q234 so that the display is triggered at the 0 volt DC level of the incoming trigger when the LEVEL control is centered. The LEVEL control varies the voltage at the base of Q234 to select the point on the trigger signal where triggering occurs.

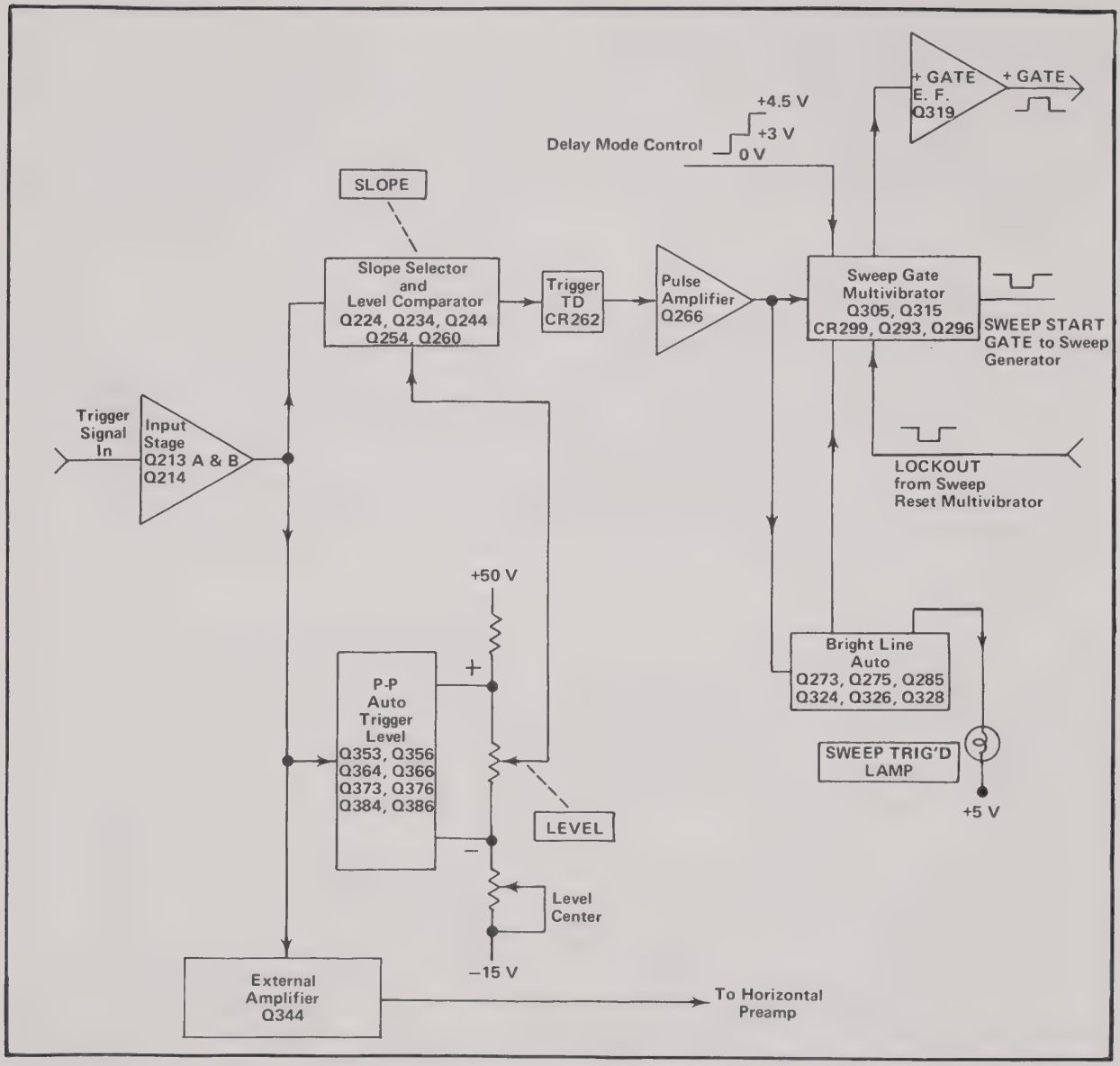


Fig. 3-3. Trigger Generator Block Diagram.

R221 establishes the emitter current for Q224 and Q234. The transistor with the most positive base controls conduction of the comparator. For example, assume that the trigger signal from the input stage is positive-going and Q224 is forward-biased. The increased current flow through R221 makes the emitter of Q234 more positive and since the base is held constant by the level control voltage, the current through Q234 decreases. The increase in current through Q224 makes the base of Q244 less positive and the decrease in current through Q234 makes the base of Q254 more positive. Refer to Fig. 3-4 for current paths for positive slope triggering. Notice that the signal currents at the collectors of Q224 and Q234 are opposite in phase. The sweep can be triggered from either the positive or negative edge of the input signal. The selection is made by the SLOPE switch, S260.

When the LEVEL control is set to midrange (MODE switch to NORM) the base of Q234 is at about 0 volts. This corresponds to the 0 volt level at the input to Q213A, and the comparator switches at the zero volt level of the trigger signal. As the LEVEL control is turned clockwise from 0/+, the voltage on the base of Q234 becomes more positive. Now the trigger signal must rise to a more positive level before comparison takes place. The resultant CRT display starts at a more positive point on the displayed signal. When the LEVEL control is turned counterclockwise from 0/+

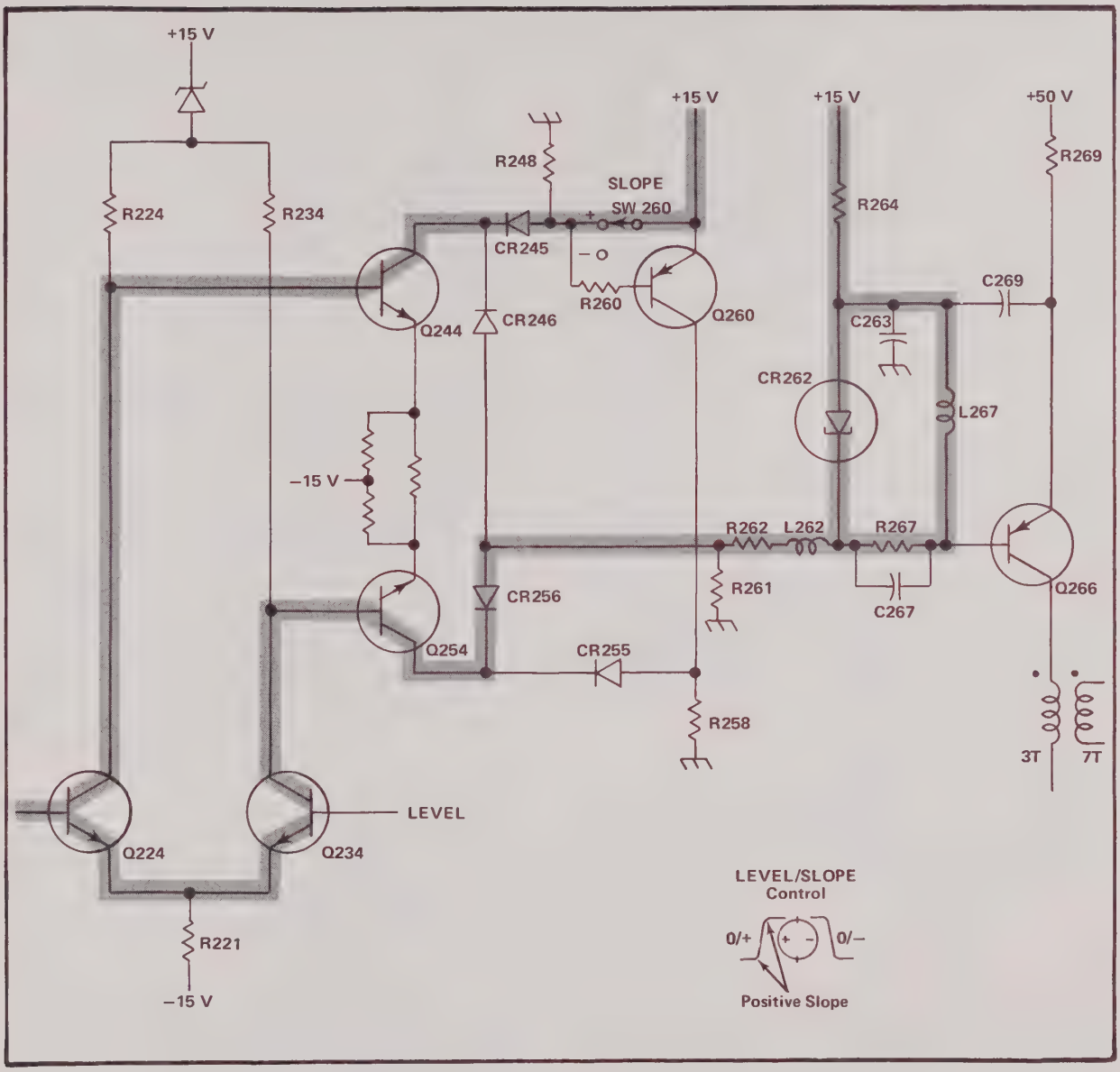


Fig. 3-4. Trigger Path for Positive Slope Triggering (simplified).

the result is the opposite of the above and produces a CRT display which starts at a more negative point along the + slope of the trigger signal.

The slope of the input signal which triggers the sweep is determined by the SLOPE switch, S260. When the SLOPE switch is set to the + position the collector of Q244 is connected to the +15 volt supply through CR245. This reverse-biases CR246 and holds Q260 cut off. With Q260 cut off, CR255 is reverse-biased. Now the collector current of Q254 must flow through CR256 and the parallel combination of CR262 and R267-C267-L267 to the +15 volt supply. Since the output pulse from the Trigger Generator circuit is derived from the negative-going portion of the signal applied to the Trigger TD Stage, the sweep is triggered on the positive-going edge of the input signal.

With the SLOPE switch set to —, conditions are reversed (see Fig. 3-5). The collector of Q254 is connected to the +15 volt supply through CR255 and Q260. CR245 and CR256 are reverse-biased and the collector current from Q244 is diverted through the Trigger TD Stage. The signal applied to the Trigger TD Stage is now in phase with the

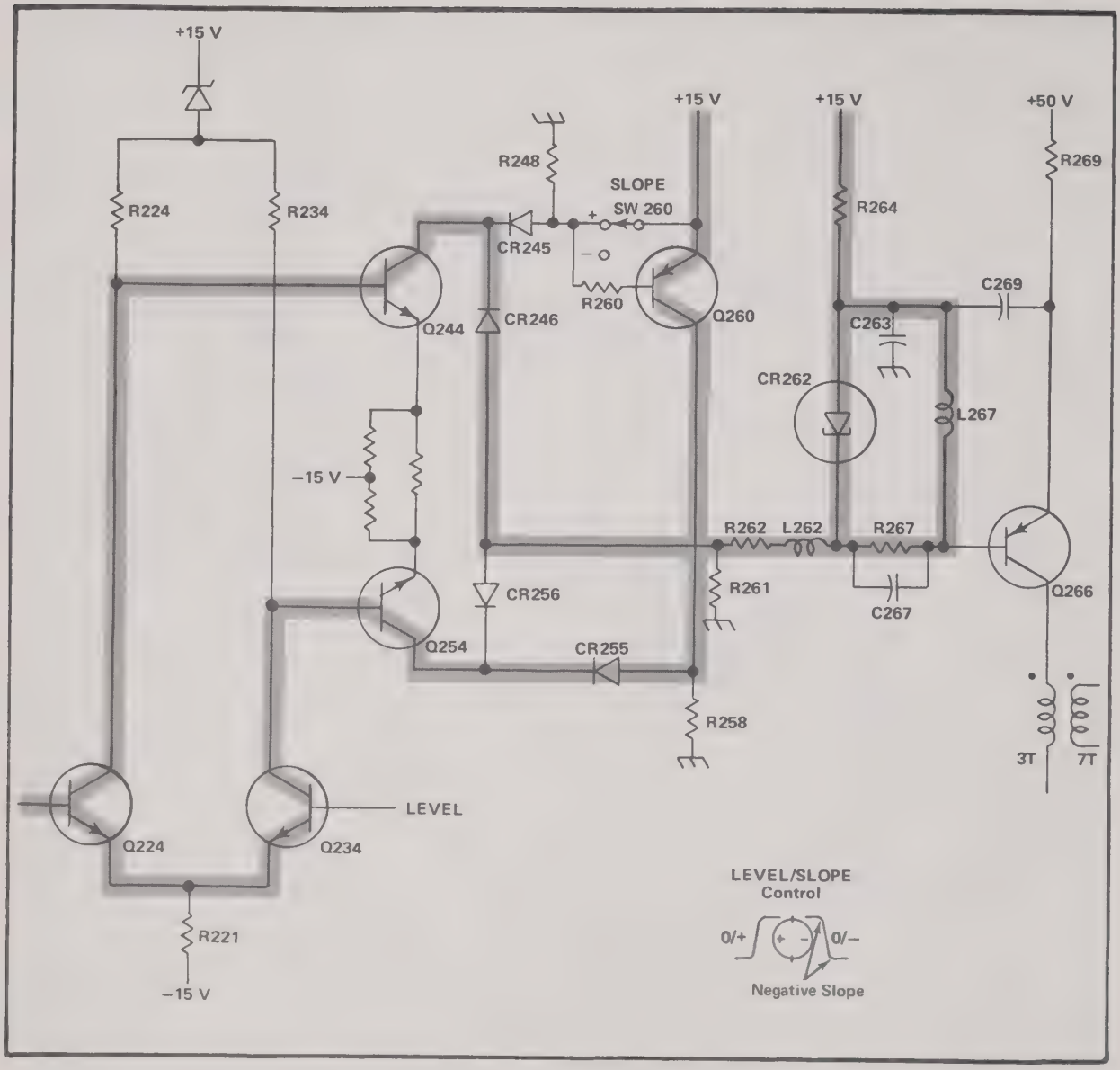


Fig. 3-5. Trigger Path for Negative Slope Triggering (simplified).

input trigger signal and the display is triggered on the negative-going edge of the input trigger signal.

Trigger TD Stage. The Trigger TD Stage shapes the output of the slope comparator to provide a trigger pulse with a fast leading edge. Tunnel diode CR262 is quiescently biased so that it is in its low-voltage state. The current from one of the transistors in the slope comparator stage is routed through the trigger TD stage by the SLOPE switch. The series-parallel combination of L267-R267-C267 with Q266 provide a resistive load from CR262 and form a Schmitt circuit. As this current increases due to an appropriate change in the trigger input signal, tunnel diode CR262 switches to its high-voltage state. CR262 reverts to its low-voltage state when the current from the slope comparator decreases sufficiently.

Pulse Amplifier. The trigger pulse from the trigger TD stage is connected to the base of the pulse amplifier, Q266. The trigger pulse at this point is basically a negative-going pulse with a fast rise. The width of the pulse is determined by the waveshape of the input trigger signal and the setting

of the LEVEL control. The negative-going pulse at the base of Q266 drives it into heavy conduction, and the resultant current increase flows through LR275-Q273-T271-Q266-R269-C269-R264.

Due to the short time constant of the coupling to Q266, the current through Q266 quickly returns to a level determined by R269. The resultant signal at the collector of Q266 is a short-duration positive-going fast-rise pulse. The positive-going pulse at the collector of Q266 is passed through non-inverting isolation transformer T271 to the sweep gate stage.

Sweep Gate Stage. The sweep gate stage produces a negative-going step to start the sweep generator and a positive gate used by the indicator oscilloscope.

The positive-going pulse from the pulse amplifier is applied to the sweep gate stage through CR291. Tunnel diode CR299 is quiescently in its low-voltage state. When a positive pulse turns on CR291, the increased current through the tunnel diode rapidly switches it to its high-voltage stage. At the end of the trigger pulse, CR291 is turned off. However, the current through R301-R303 will maintain the tunnel diode in its high-voltage state until reset by the sweep reset multivibrator at the end of the sweep.

The positive-going level at the anode of CR299 is applied to the base of Q305. Q305 turns on and the increased current causes a negative-going step on the collector. This negative-going step is used to enable the sweep generator. When Q305 turns on, emitter-coupled Q315 turns off and the positive-going step on its collector is passed through emitter-follower Q319 as the + Gate out.

At the end of the sweep, the negative-going lockout gate from the sweep reset multivibrator is applied to the base of Q296. As Q296 turns off Q293 turns on and steals current from CR299, reverting CR299 to its low-voltage stage. This switches the sweep gate multivibrator back to its quiescent state (Q305 off, Q315 on). The circuit remains in this condition (CR299 in its low-voltage stage) until the lockout gate returns to its high-level. When the lockout gate goes high, Q296 turns on and Q293 is turned off. Now, CR299 is unlatched and ready for the next trigger pulse.

Bright Line Auto. The operation of the sweep gate stage in the P-P AUTO or AUTO MODE of operation is the same as for the NORM MODE just described when a trigger pulse is applied. However, when a trigger pulse is not present, a free-running trace is produced in the P-P AUTO and AUTO MODES.

With no trigger pulse applied to the circuit, Q273 is at a low current level. The anode of CR275 is at ground potential. This clamps the base of Q275 at about −0.7 volt and it is not conducting. C282 is charged to a positive level determined by R277, R322 and R323. The base voltage of Q324 is higher than that of Q326, so Q326 is conducting. This additional current from Q326 through CR299 switches CR299 to its high-voltage state, automatically retriggering the sweep each time the lockout gate goes to its high-voltage state. The result is that the sweep generator circuit is automatically retriggered at the end of each holdoff period and a free-running trace is produced. Since the trace free-runs at the sweep rate of the sweep generator circuit (as selected by the TIME/DIV switch), a bright reference trace is produced at all sweep rates. The sweep TRIGGERED lamp will not be lit, indicating an untriggered condition.

The sweep TRIGGERED lamp is lit each time a trigger pulse is received from the pulse amplifier, Q266. The trigger pulse turns on Q275, which discharges C282. CR277 is turned off and the base of Q324 becomes less positive. Q324 is turned on, pulling the base of Q328 positive to turn-on. Q328 collector current lights the sweep TRIGGERED lamp. Q326 is emitter-coupled to Q324, and is turned off by the conduction of Q324. This disconnects the bright line auto circuit from the sweep gate circuit when an adequate signal is present to prevent the sweep from free-running.

When the TRIGGERING MODE switch is in the NORM or SINGLE SWEEP position, the anode of CR321 is clamped to ground. This reverse-biases CR321 and disconnects the bright line auto circuit from the sweep gate circuit.

External Amplifier

When the DISPLAY MODE switch is set to AMPLIFIER, the −15 volts is disconnected from the bright-line auto multivibrator and the sweep gate multivibrator. This disables the sweep generator circuit. The indicator oscilloscope readout for the Type 7B50 is also disabled by applying +15 volts through R728 to interface connector A37.

The signal, external or internal as selected by the SOURCE switch, is applied to the base of Q333 through input FET Q213, and emitter-follower Q214. See Fig. 3-6. The emitter current of Q333, which was switched from the P-P Auto Level circuit to the External Amplifier circuit by the DELAY MODE switch, couples the signal to the emitter of the external amplifier (Q344) through the VARIABLE control (R340). This control varies the gain of the External Amplifier by a factor of up to 10. With the VARIABLE control fully clockwise, the deflection factor is about 90

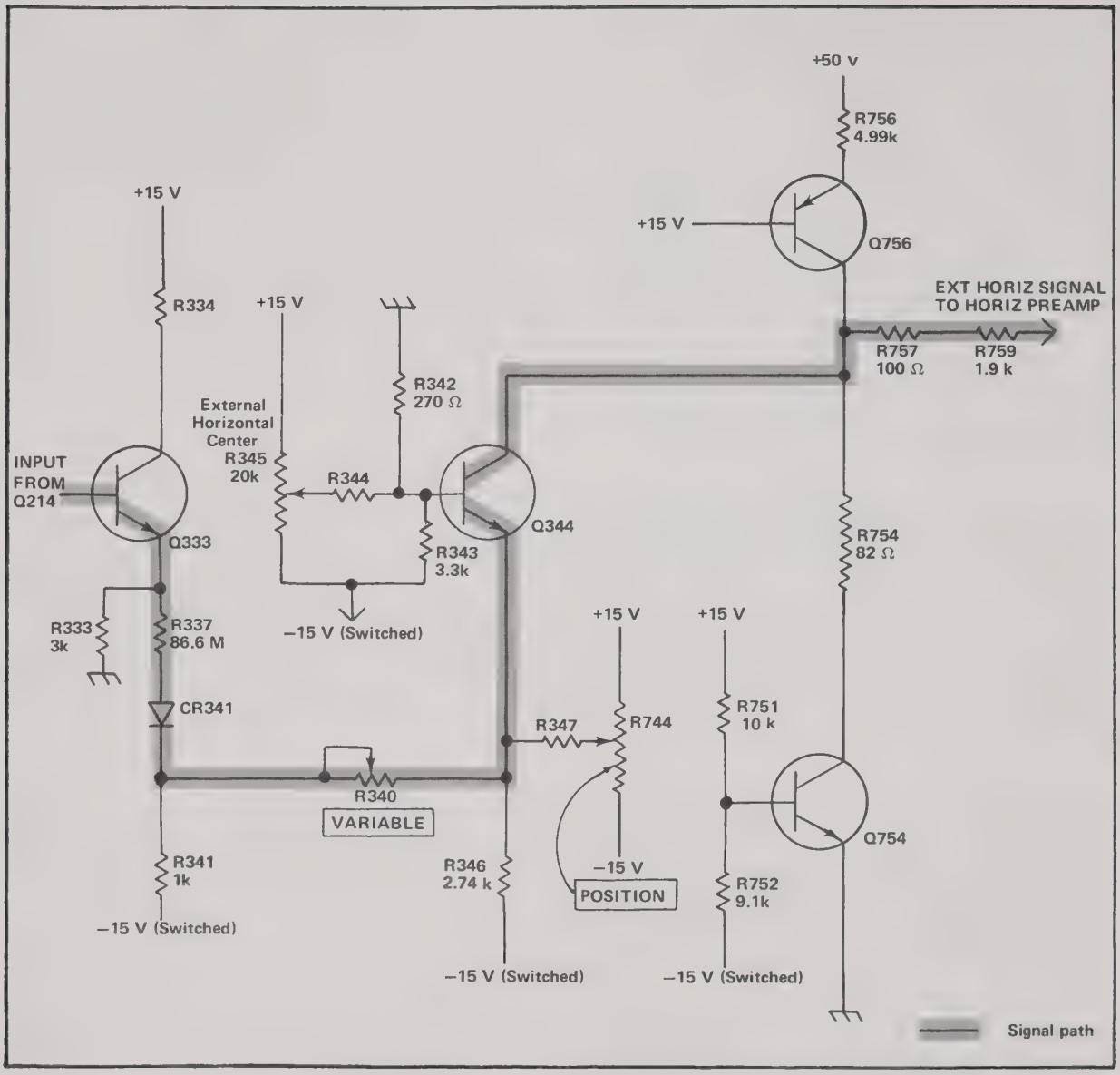


Fig. 3-6. Simplified drawing of External Amplifier.

millivolts per division and with the VARIABLE fully counterclockwise the deflection factor is about 900 millivolts per division.

External Horizontal Center (R345) sets the DC level of the amplifier so there is no horizontal movement of the spot as the VARIABLE control is rotated. Q756 is the current source for the external amplifier. Q754 is off when the DISPLAY MODE switch is in the AMPLIFIER position. In the TIME BASE position, the External Amplifier is turned off and Q754 is turned on to accept the current from Q756.

SWEEP GENERATOR

General

The Sweep Generator circuit (see Fig. 3-7) produces a sawtooth voltage which is changed from single-ended to push-pull by the Horizontal Preamp and used by the Indicator Oscilloscope to provide horizontal sweep deflection on the CRT. In addition, this circuit produces various control signals for use by the Indicator Oscilloscope as well as internal signals for use in the plug-in.

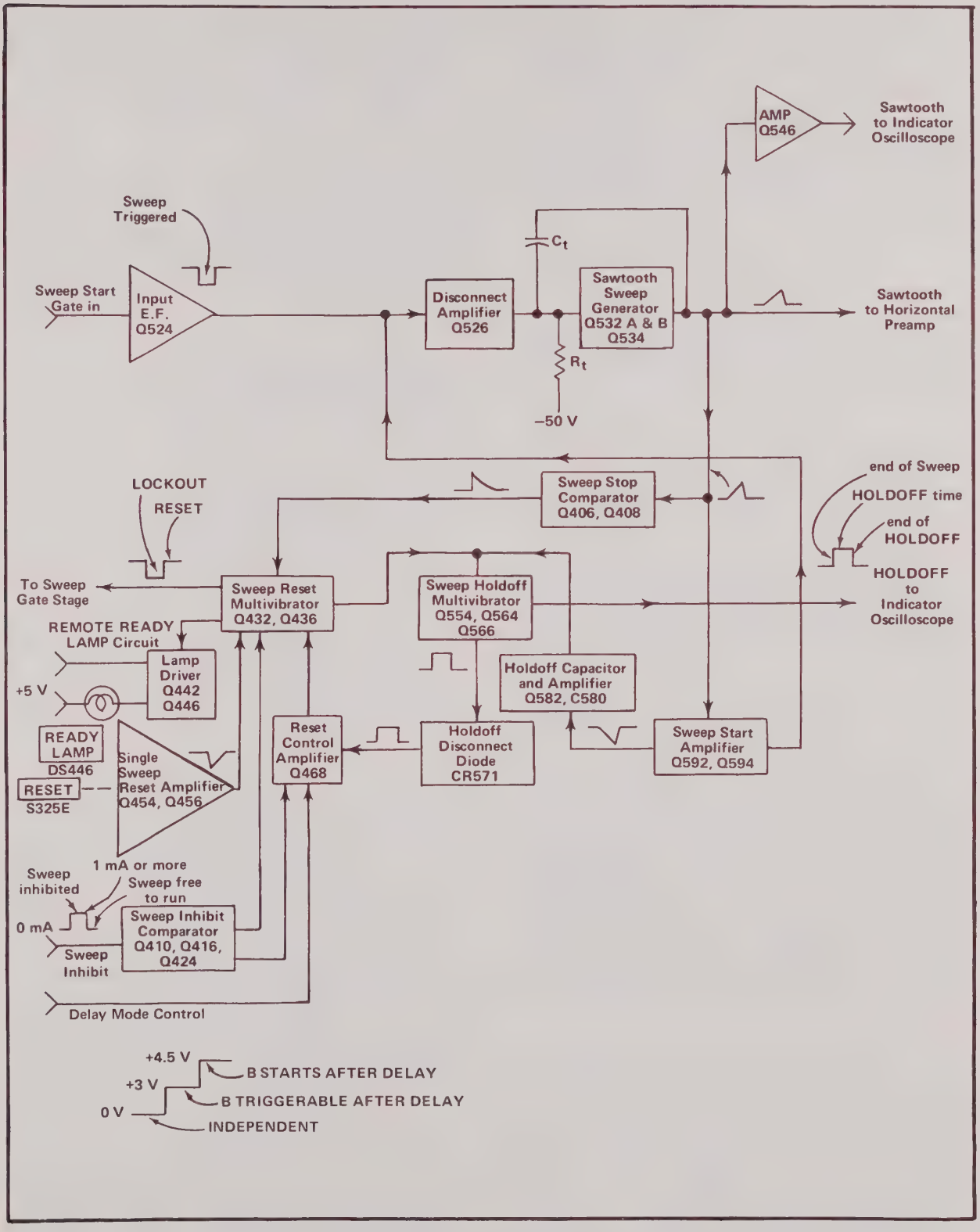


Fig. 3-7. Sweep Generator Block Diagram.

Normal Trigger Mode Operation

Disconnect Amplifier. The Disconnect Amplifier, Q526, is quiescently conducting current through R523 and the Timing Resistor, R530. The negative-going step from the Sweep Gate Multivibrator is applied to the base of the input emitter-follower, Q524. Q524 couples the negative step to the emitter of Disconnect Amplifier Q526, turning it off. The timing current through Timing Resistor R530, now starts to charge Timing Capacitor C530, enabling the Sweep Generator.

The Disconnect Amplifier is a low leakage transistor to improve timing at low sweep speeds and high temperatures. At the end of the sweep, Q526 turns on, discharging the Timing Capacitor. CR525 provides isolation between the Disconnect Amplifier and the input emitter-follower during holdoff time.

Sawtooth Sweep Generator. The basic sweep generator circuit is a Miller Integrator Circuit.[1] The current flow through the Disconnect Amplifier is interrupted by the signal from the Sweep Gate Stage.

Timing Capacitor C530 now begins to charge through Timing Resistor R530. The Timing Resistor and Timing Capacitor are selected by the TIME/DIV switch (a front panel control) to provide sweep rates as listed on the front panel.

As the Timing Capacitor begins to charge toward the voltage applied to the Timing Resistor, the gate of Q532A (which is tied to the junction of R530-C530), goes negative by the same amount. This decreases the current through Q532A, forcing more current through Q532B. This increase in Q532B drain current flowing through R534 gives a negative-going voltage at the base of Q534. This causes its collector voltage to pull up. The positive side of the Timing Capacitor, being tied to the collector of Q534, is also pulled up. This action results in a positive-going voltage being applied across the Timing Capacitor, maintaining a constant charging current and giving a linear rate of rise to the sawtooth output signal. The sawtooth output signal continues to rise in this manner until the Sweep Gate Multivibrator is switched to turn on the Disconnect Amplifier.

The sawtooth output from the collector of Q534 is connected to the Horizontal Preamp, and through R539 to the Sweep Start Amplifier, Sweep Stop Comparator, and through amplifier Q546 to the Indicator Oscilloscope. CR534 protects against reverse emitter-base breakdown of Q534. CR529 protects against gate-source breakdown of Q532A.

[1] MILLMAN & TAUB, pp 540-548

Sweep Start Amplifier. Q594 sets the quiescent voltage of the sawtooth. The collector current of Q594, flowing through R523, establishes the correct starting point of the sawtooth output signal. L593-R596 prevent oscillations at the faster sweep rates. They are paralleled with R592 at the slower sweep rates. CR594 and CR592 prevent base-emitter breakdown of Q594 and Q592.

The sawtooth signal is applied through R539 to the base of Q592. This positive-going signal causes Q592 to turn on harder, pulling down its collector voltage. As the emitter of Q592 moves positive due to the increase in current, CR597 turns on to switch the current through R598 to Q592 to make a more definite step.

The negative-going voltage at the collector of Q592 is applied through current-limiting diode, CR581, to the base of Q582 to charge the holdoff capacitor.

Sweep Stop Comparator. The Sweep Stop Comparator is used to terminate the sawtooth sweep when the sweep has reached a predetermined length. Quiescently Q406 is biased off by voltage divider, R404-R405. These resistors set the reference level for sweep termination at approximately +10.5 volts. When the sawtooth sweep rises to about +10.5 volts, Q408 is turned off. Q406 is turned on and the positive-going rise at the base of Q436 switches the reset multivibrator. The voltage at the collector of Q436 goes negative and this negative gate applied to the sweep gate circuit ends the sweep.

Holdoff Capacitor and Amplifier. Q582, which is turned on during sweep time, charges the holdoff capacitor. When the sweep ends, Q582 turns off. Now the holdoff capacitor starts to discharge toward −50 volts through R582, and at some sweep speeds, through R580. When the top of C580 discharges enough in the negative direction to forward-bias CR574 and CR579, the holdoff capacitor voltage is applied to the base of Q554. This drives Q554 to cutoff, switching the holdoff multivibrator to end holdoff time. Voltage limiting diodes CR580 and CR582 protect the base-emitter junction of Q582. CR581 limits the "on" base current of Q582. Capacitor C582 and the current through R581 determine the rate of charge of the holdoff capacitor, C580. VR576 and CR578 limit the negative voltage on the holdoff capacitor, C580.

The HF STAB control R260B through R583 varies the discharge rate of the holdoff capacitor to provide a stable display at fast sweep rates. This change in holdoff allows sweep synchronization for less display jitter at the faster sweep rates. The HF STAB circuit has little effect at slow sweep rates.

Sweep Holdoff Multivibrator. Q554-Q564 are connected in a bistable Schmitt Trigger configuration. Quiescently, Q554 is off and Q564 is on. A positive pulse from the sweep reset multivibrator switches the holdoff multivibrator to its second stable state, Q554 on and Q564 off.

The sweep holdoff multivibrator is returned to its first stable state when the holdoff capacitor has charged negative enough to drive Q554 to cutoff. The fast switching action of the sweep holdoff multivibrator produces sharp leading and trailing edges for the sweep holdoff gate. The output of the multivibrator, coupled through emitter-follower Q566, goes to the indicator oscilloscope and to the holdoff disconnect diode.

During sweep time the voltage on the holdoff capacitor reverse-biases CR579 and the current in R573 switches to CR572, turning off Q468. VR573 determines the time when the current switch takes place. During holdoff time, holdoff disconnect diode CR571 controls the current available to the reset control amplifier, Q468. The positive-going edge of the holdoff gate turns CR571 on. This moves the emitter of Q468 positive, turning it off. At the end of holdoff time the negative-going edge of the holdoff gate opens CR571, making the current through R468 available to the reset control amplifier.

Reset Control Amplifier. Q468 provides current to the base of Q436 to switch the sweep reset multivibrator to its reset state. The current through R468 into the emitter of Q468 is controlled by CR571 and CR572 as stated above, or by CR468 as explained under single-sweep operation.

Sweep Reset Multivibrator. The sweep reset multivibrator, Q432-Q436, resets the sweep gate TD at the end of holdoff time. In the reset state, Q432 is off and Q436 is conducting. The junction of R437-R438 is pulled up to its high level. The sweep is terminated by current from Q406 moving the base of Q436 positive to cutoff. This switches the multivibrator to its other stable state; Q432 on and Q436 off. The voltage at the junction of Q437-R438 drops negative to its low-level. This negative step is applied to the sweep gate stage to latch the sweep gate TD in its low-voltage state. At the end of holdoff time Q468 is turned on, driving the base of Q436 less positive. This turns Q436 on and the multivibrator switches back to its reset state. The voltage at the junction of R437-R438 is pulled up to its high level. This positive-going step is applied to the Sweep Gate Stage to unlatch the Sweep Gate TD, and the sweep circuits are ready for the next sweep to start.

Single Sweep Operation

General. Operation of the Sweep Generator Circuit in the SINGLE SWEEP position of the TRIGGERING MODE switch is similar to operation in the other modes. However, after one sweep has been produced, the Sweep Reset Multivibrator Stage does not reset. All succeeding trigger pulses are locked out until the RESET button is pressed.

In the SINGLE SWEEP position of the MODE switch, the −15 volts is removed from the top of R464. CR466 is opened and CR468 becomes forward-biased, opening a current path through R468-CR468-R466. Now, at the end of holdoff, there is no current through Q468 to pull down the base of Q436, and the Sweep Reset Multivibrator does not reset. The circuit remains in this condition until reset by the Single Sweep Reset Amplifier Stage.

Single Sweep Reset Amplifier. The Single Sweep Reset Amplifier produces a negative pulse to reset the Sweep Reset Multivibrator stage so another sweep can be produced in the SINGLE SWEEP mode of operation.

Quiescently, Q454 is conducting hard and Q456 is held cut off. When the RESET button is pressed, CR451 is turned on. This clamps the junction of CR451-CR453 at +0.6 volt. CR453 and CR454 open and the base of Q454 drops to zero volts, turning it off. This turns Q456 on hard, pulling down its collector voltage. This negative-going step applied to C457-CR459 produces a negative pulse at the base of Q436 which is sufficient to reset the sweep reset multivibrator. This enables the sweep gate TD, and the next trigger pulse will produce another sweep on the display. C456 provides positive feedback with a long time-constant to keep Q454 off long enough to prevent switching transients from producing multiple sweeps.

Lamp Driver. In the SINGLE SWEEP MODE, the base of Q446 is connected through CR446, CR448 and CR449 to the collector of Q436. When Q436 is cut off, during holdoff time and until the RESET button is pressed, the base of Q446 is biased to cutoff. When the RESET button is pressed, Q436 is turned on and its collector voltage rises. This positive-going voltage applied to the base of Q446 turns it on (C446 controls turn-on time). Q446 collector voltage drops and the READY lamp turns on. The READY lamp remains on until the end of the sweep when Q436 is again turned off.

Alternate Operation

In alternate operation the indicator oscilloscope provides a sweep inhibit current to the emitter of Q410. Q410 provides a low impedance input and a voltage drive for the inhibit comparator, Q416 and Q424. A sweep inhibit current input of 1 mA or greater turns Q410 on. This raises the base voltage of Q416, turning it on and turning Q424 off. The collector current of Q416 pulls the base of Q432 in a negative direction turning, Q432 on and Q436 off, to latch the sweep gate TD as described previously.

Delayed Sweep Operation

In this mode of operation, the time-base in the left horizontal (A) compartment provides the sweep inhibit current to the emitter of Q410. The sweep inhibit circuit operates as described under Alternate Operation. The A time-base also provides a delay mode control voltage to the anodes of CR462 in the sweep generator and CR301 in the trigger generator.

The delay mode control voltage causes CR462 to conduct CR463 to turn off, CR464 to conduct and CR466 to turn off. This puts the B sweep in single sweep mode as described under Single Sweep Operation.

During sweep inhibit time, Q424 is turned off. This turns off CR428 and with CR463 off the current from R428 turns on CR469. C469 now charges to about +1.5 volts, turning on Q468. This does not reset the sweep, which is locked out by the conduction of Q416.

When sweep inhibit ends Q416 turns off, making the base of Q432 more positive. Q424 turns on to open CR469. C469 holds its charge long enough to allow Q468 to reset the sweep at the end of inhibit time. This action allows only one sweep at the end of inhibit time. This action allows only one sweep after each time the sweep is inhibited.

The delay mode control voltage is also connected to the sweep gate TD, CR299, through CR301 and R303. With the A time-base B DELAY MODE in B TRIGGERABLE AFTER DELAY the control voltage is about +3 volts, which is insufficient to cause CR301 to conduct. The sweep will wait for the first trigger after the delay interval to run. With the A time-base B DELAY MODE in B STARTS AFTER DELAY, the control voltage is about +4.5 volts. This is sufficient to cause CR301 to conduct and increase the current through R303 to the sweep gate TD, CR299. Now the TD will change to its high-level state and start the sweep as soon as it is enabled by the sweep reset multivibrator at the end of inhibit current to Q410.

HORIZONTAL PREAMP

Input Amplifier. The Input Amplifier, Q764, is an operational (feedback) amplifier which provides stable gain and low input impedance. POSITION control R744 A and B, varies the DC level at the base of paraphase amplifier Q784 to position the display horizontally. R771-R772-Q774 supply a stable DC reference level to the base of Q794. Sweep Cal adjustment R740 adjusts the sawtooth input current. This controls the rate of rise of the sawtooth output of the Paraphase Amplifier.

Paraphase Amplifier. The Paraphase Amplifier, Q784-Q794, takes the single-ended input and converts it to a push-pull output for use in the Indicator Oscilloscope.

The negative-going sawtooth applied to the base of Q784 increases conduction in this half of the Paraphase Amplifier. Through emitter-follower action the negative-going sawtooth signal is also applied to the emitter of Q794, decreasing conduction through this half of the Paraphase Amplifier. The results of these actions are a positive-going sawtooth at the collector of Q784 and a negative-going sawtooth at the collector of Q794.

Magnifier. Relay K780, when energized parallels R782 with R786-R785 to increase the gain of the amplifier by a factor of 10. R785 is adjustable for calibration of the X10 gain. Mag Regis adjustment R795 is used to balance the output for no trace shift when switching the X1 to X10 magnification.

READOUT BLOCK

The Readout Block consists of switching resistors and a set of contacts operated by the X10 MAG relay. The switching resistors, selected by the setting of the Readout Switch (part of the TIME/DIV switch), are used to signal the Indicator Oscilloscope of the setting of the TIME/DIV switch.

Refer to Schematic Diagram 4, Timing Switch, at the back of the manual to find the resistors associated with a particular setting of the TIME/DIV switch. The number 1, 2, or 5 is selected by resistors R704-R705-R706. The number of zeros is selected by resistors R711-R712-R713-R715. The TIME sub-unit (milli, micro, or nano) is selected by resistors R721-R722-R723-R724. R728-R729 select the symbol s (seconds). R701-R702 select the symbol > (greater than) when the VAR TIME/DIV knob is in the out (uncal) position. R715 is switched out by the X10 MAG to increase the displayed readout by a factor of 10.

SECTION 4
MAINTENANCE

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance and troubleshooting of the Type 7B50.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis may prevent instrument breakdown and will improve the reliability of this instrument. The severity of the environment to which the Type 7B50 is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding recalibration of the instrument.

Cleaning

The Type 7B50 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It may also provide an electrical conduction path.

The covers of the indicator oscilloscope minimize the amount of dust which reaches the interior of the Type 7B50. Operation of the system without the indicator oscilloscope covers in place necessitates more frequent cleaning. When the Type 7B50 is not in use, it should be stored in a protected location such as a dust-tight cabinet.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone or similar solvents.

Exterior. Loose dust accumulated on the outside of the Type 7B50 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners can not be used.

Interior. Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

Visual Inspection

The Type 7B50 should be inspected occasionally for such defects as broken connections, broken or damaged circuit boards, improperly seated transistors or relay, and heat-damaged parts.

The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent a recurrence of the damage.

Transistor Checks

Periodic checks of the transistors in the Type 7B50 are not recommended. The best check of transistor performance is actual operation in the instrument. More details on checking transistor operation are given under Troubleshooting.

Recalibration

To ensure accurate measurements, check the calibration of this instrument after each 1000 hours of operation or every six months if used infrequently. In addition, replacement of components may necessitate recalibration of the affected circuits. Complete calibration instructions are given in Section 5.

The Performance Check/Calibration Procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed and/or corrected by calibration.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the Type 7B50. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles. See the Circuit Description section for complete information.

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in Section 7. The component number and electrical value of each component in this instrument are shown on the diagrams. Important voltages and waveforms are also shown on the diagrams.

Switch Cam Identification. Switch cam numbers shown on the diagrams indicate the position of the cam in the complete switch assembly. The cams are numbered from the front, or mounting end of the switch, toward the rear.

Resistor Color-Code. In addition to the brown composition resistors, some metal-film resistors and some wire-wound resistors are used in the Type 7B50. The resistance values of wire-wound resistors are printed on the body of the component. The resistance values of composition resistors and metal-film resistors are color-coded on the components (some metal-film resistors may have the value printed on the body) with EIA color code. The color code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes which consist of two significant figures, a multiplier and a tolerance value (see Fig. 4-1). Metal-film resistors have five stripes consisting of three significant figures, a multiplier and a tolerance value.

Capacitor Marking. The capacitance values of common disc capacitors and small electrolytics are marked in microfarads on the side of the component body. The white ceramic capacitors used in the Type 7B50 are color coded in picofarads using a modified EIA code (see Fig. 4-1).

Diode Color Code. The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes or a dot. For most silicon or germanium diodes with a series of stripes, the color code also indicates the type of diode or identifies the Tektronix Part Number using the resistor color code system (e.g., a diode color-coded blue- or pink-brown-gray-green indicates Tektronix Part Number 152-0185-00). The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

Troubleshooting Equipment

The following equipment is useful for troubleshooting the Type 7B50:

1. Transistor Tester

Description: Tektronix Type 576 Transistor-Curve Tracer or equivalent.

Purpose: To test the simiconductors used in this instrument.

2. Volt-ohmmeter

Description: 20,000 ohms/volt. 0-50 volts DC. Accurate within 3%. Test probes must be well insulated.

Purpose: To measure voltages and resistances.

3. Test Oscilloscope

Description: DC to 100 MHz frequency response, 5 millivolts to 5 volts/division deflection factor. Use a 10X probe.

Purpose: To check waveforms in the instrument.

4. Plug-In Extender

Description: Rigid plug-in extender, Tektronix Part number 067-0589-00.

Purpose: Permits operation of the unit outside the plug-in compartment for better accessibility during troubleshooting.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation and calibration. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced following the replacement procedures given under Corrective Maintenance.

1. Check Control Settings. Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section.

2. Check Associated Equipment. Before proceeding with troubleshooting of the Type 7B50, check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the probe cable is not defective. The indicator oscilloscope and vertical plug-in unit can be checked for proper operation by substituting another time-base unit which is known to be operating properly (perferably another Type 7B50 or similar unit). If the trouble persists after substitution, the indicator oscilloscope and/or vertical plug-in unit is defective.

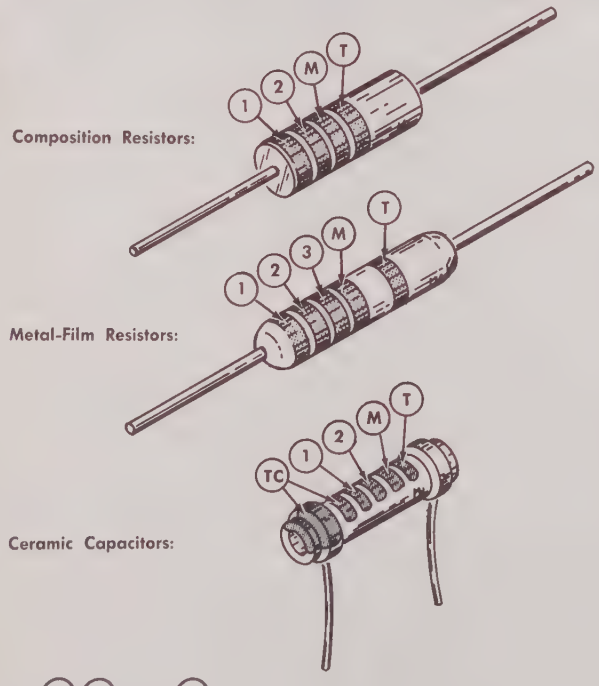
3. Check Instrument Calibration. Check the calibration of this instrument, or the affected circuit if the trouble exists in one circuit. The apparent trouble may only be a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in the Calibration section.

4. Visual Check. Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visual indications such as unsoldered connections, broken wires, damaged components, etc.

5. Isolate Trouble to a Circuit. To isolate a trouble to a circuit, note the trouble symptom. The symptom often indicates the circuit in which the trouble is located. For example, if normal triggering can be obtained in the EXT mode but cannot be obtained in the INT mode, the trigger pre-amp or the input coupling circuit is probably at fault. When trouble symptoms appear, use the front-panel controls and the CRT display to try to isolate the trouble to one circuit. When the trouble appears in more than one circuit, check all affected circuits by taking voltage and waveform readings.

Fig. 4-2 provides a guide to aid in locating a defective circuit. This chart does not include checks for all possible defects; use steps 6 and 7 for further troubleshooting. Start from the top of the chart and perform the given checks on the left side of the page until a step is found which is not correct. Further checks and/or the circuit in which the trouble is probably located are listed to the right of this step.

After the defective circuit has been located, proceed with steps 6 and 7 to locate the defective component(s).



(1) (2) and (3) —1st, 2nd and 3rd significant figures;
(M) —multiplier; (T) —tolerance;
(TC) —temperature coefficient.

Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier: Resistors	Multiplier: Capacitors	Tolerance: Resistors	Tolerance: Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% −0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% −20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less.

NOTE: (T) and/or (TC) color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 4-1. Color-code for resistors and ceramic capacitors.

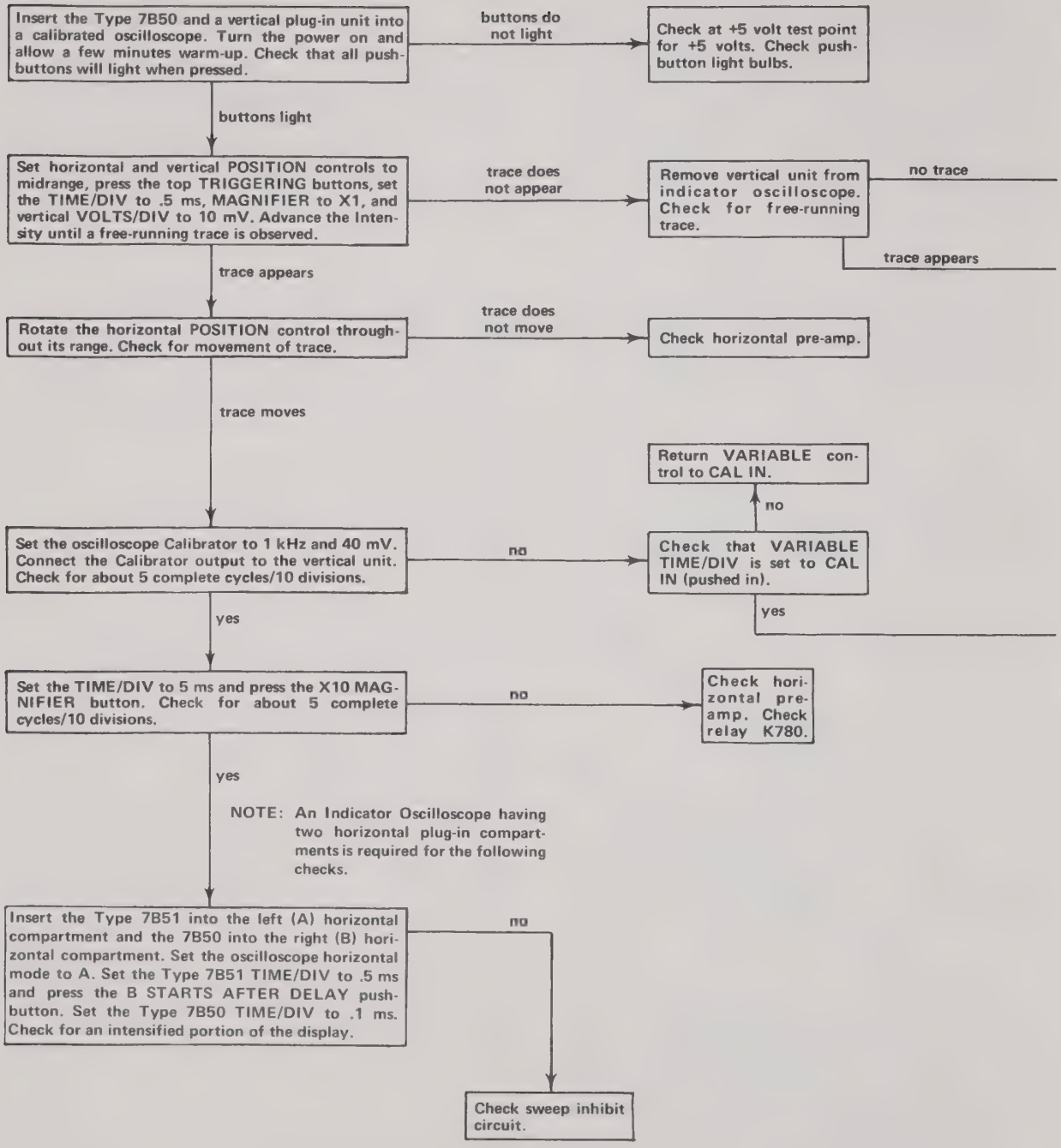
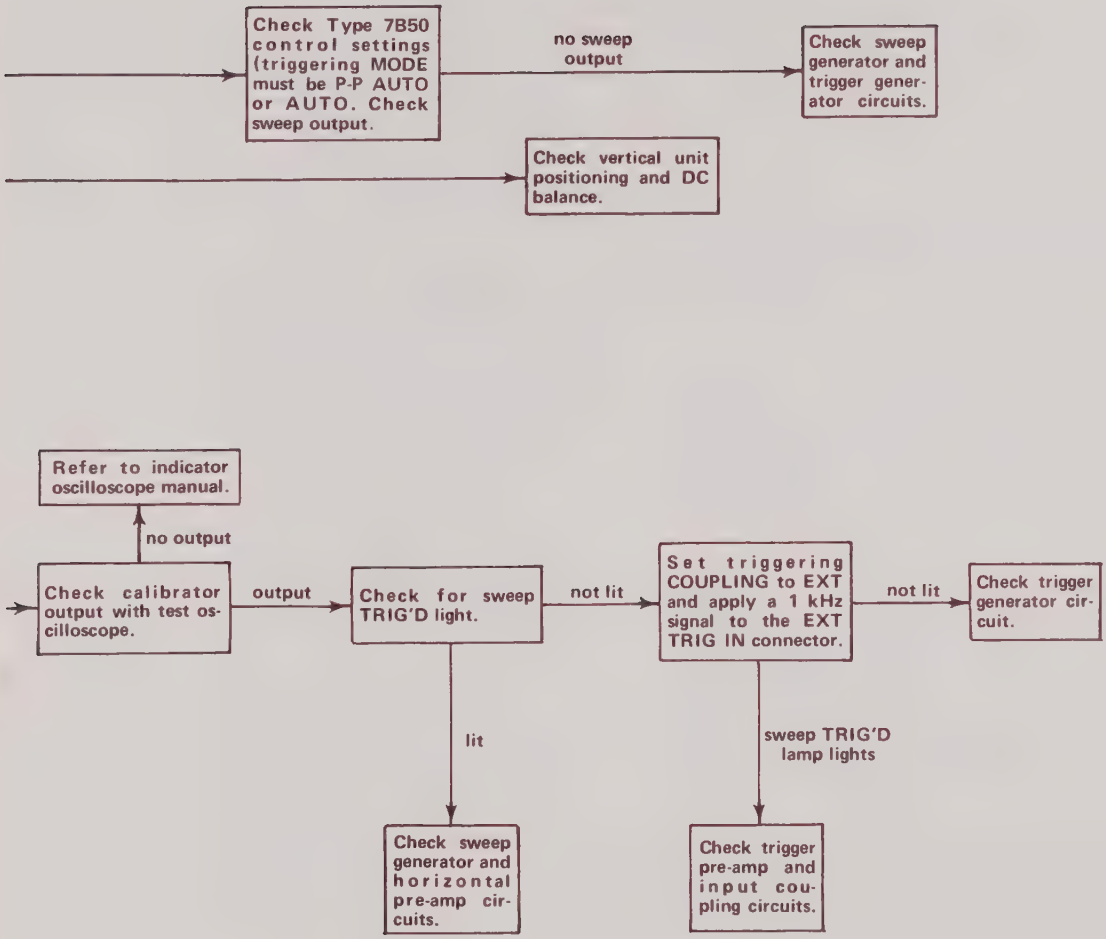

Insert the Type 7B50 and a vertical plug-in unit into a calibrated oscilloscope. Turn the power on and allow a few minutes warm-up. Check that all push-buttons will light when pressed.
buttons do not light
Check at +5 volt test point for +5 volts. Check push-button light bulbs.
buttons light
Set horizontal and vertical POSITION controls to midrange, press the top TRIGGERING buttons, set the TIME/DIV to .5 ms, MAGNIFIER to X1, and vertical VOLTS/DIV to 10 mV. Advance the Intensity until a free-running trace is observed.
trace does not appear
Remove vertical unit from indicator oscilloscope. Check for free-running trace.
no trace
trace appears
trace appears
Rotate the horizontal POSITION control throughout its range. Check for movement of trace.
trace does not move
Check horizontal pre-amp.
trace moves
Return VARIABLE control to CAL IN.
no
Set the oscilloscope Calibrator to 1 kHz and 40 mV. Connect the Calibrator output to the vertical unit. Check for about 5 complete cycles/10 divisions.
no
Check that VARIABLE TIME/DIV is set to CAL IN (pushed in).
yes
yes
Set the TIME/DIV to 5 ms and press the X10 MAGNIFIER button. Check for about 5 complete cycles/10 divisions.
no
Check horizontal pre-amp. Check relay K780.
yes
NOTE: An Indicator Oscilloscope having two horizontal plug-in compartments is required for the following checks.
Insert the Type 7B51 into the left (A) horizontal compartment and the 7B50 into the right (B) horizontal compartment. Set the oscilloscope horizontal mode to A. Set the Type 7B51 TIME/DIV to .5 ms and press the B STARTS AFTER DELAY pushbutton. Set the Type 7B50 TIME/DIV to .1 ms. Check for an intensified portion of the display.
no
Check sweep inhibit circuit.

Fig. 4-2. Troubleshooting chart for the Type 7B50.


Check Type 7B50 control settings (triggering MODE must be P-P AUTO or AUTO. Check sweep output.
no sweep output
Check sweep generator and trigger generator circuits.
Check vertical unit positioning and DC balance.
Refer to indicator oscilloscope manual.
no output
Check calibrator output with test oscilloscope.
output
Check for sweep TRIG'D light.
not lit
Set triggering COUPLING to EXT and apply a 1 kHz signal to the EXT TRIG IN connector.
not lit
Check trigger generator circuit.
lit
sweep TRIG'D lamp lights
Check sweep generator and horizontal pre-amp circuits.
Check trigger pre-amp and input coupling circuits.

For a trouble not covered by this chart, use the troubleshooting methods in steps 6 and 7 of the troubleshooting techniques.

Fig. 4-2. Troubleshooting chart for the Type 7B50.

6. Check Voltages and Waveforms. Often the defective components can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given on the diagrams.

CAUTION

Do not clamp probe to pin connectors as this may break or damage the connectors.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the first diagram page.

7. Check Individual Components. The following procedures describe methods of checking individual components in the Type 7B50. Components which are soldered in place are best checked by disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

A. RELAY. The eight-pin relay used in the Type 7B50 is symmetrical and may be replaced in its socket facing either direction. This relay, which is plugged into the circuit board, may be removed and checked. Use an ohmmeter to check the 600 Ω resistance. The relay may also be actuated by placing +15 volts across the coil. The internal connections are printed on the body of the relay.

B. TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new component or one which has been checked previously. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester (such as Tektronix Type 576).

C. DIODES. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 millivolts and 3 volts, the resistance should be very high in one direction and very low when the leads are reversed.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode.

D. RESISTORS. Resistors can be checked with an ohmmeter. Check the Electrical Parts List for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

E. INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response.

F. CAPACITORS. A leaky or shorted capacitor can best be detected by checking the resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

8. Repair and Readjust the Circuit. If any defective parts are located, follow the replacement procedures given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

CORRECTIVE MAINTENANCE

General

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in this instrument are given here.

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the Type 7B50 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect the performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are used in the Type 7B50. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument Type.
2. Instrument Serial Number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix Part Number.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

Circuit Boards. The components mounted on the circuit boards in the amplifier can be replaced using normal circuit board soldering techniques. Keep the following points in mind when soldering on the circuit boards.

1. Use a pencil-type soldering iron with a power rating from 15 to 50 watts.

2. Apply heat from the soldering iron to the junction between the component and the circuit board.

3. Heat-shunt the lead of the component by means of a pair of long-nosed pliers.

4. Avoid excessive heating of the junction with the circuit board, as this could separate the circuit board wiring from the laminate.

5. Use electronic grade 60-40 tin-lead solder.

6. Clip off any excess lead length extending beyond the circuit board and clean off any residual flux with a flux-removing solvent. Be careful that the solvent does not remove any printing from the circuit board.

Metal Terminals. When soldering metal terminals (e.g., switch terminals, potentiometers, etc.), use 60-40 tin-lead solder and a 15 to 50 watt soldering iron. Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-removing solvent.

Component Replacement

WARNING

Disconnect the equipment from the power source before replacing components.

Relay Replacement. The relay in the Type 7B50 is manufactured by Tektronix, Inc. If the relay fails, a replacement may be ordered from your local Tektronix Field Office or representative. The eight-pin DPDT relay may be replaced in its socket facing either direction, as this relay is symmetrical.

Transistor Replacement. Transistors should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of transistors may effect the calibration of this instrument. When transistors are replaced, check the operation of that part of the instrument which may be affected.

Replacement transistors should be of the original type or a direct replacement. Remount the transistors in the same manner as the origintal. Fig. 4-3 shows the lead configurations of the transistors used in this instrument. This view is as seen from the bottom of the transistor. When replacing transistors, check the manufacturer's basing diagram for correct basing.

Interconnecting Pins and Pin Socket Replacement. Two types of mating connectors are used for these interconnecting pins. If the mating connector is mounted on a plug-on circuit board, a special socket is soldered into the board. If the mating connector is on the end of a lead, a pin connector is used to mate with the interconnecting pin. The following information provides the replacement procedure for the various types of pins and pin sockets.

A. CIRCUIT BOARD PINS. To replace a pin which is mounted on a circuit board, first disconnect any pin connectors. Unsolder the damaged pin and pull it out of the circuit board. Press the new pin into the hole in the circuit board so the ferrule on the pin is centered in the hole in the board. (Notice that the ferrule is not centered on the pin; be sure the replacement pin is positioned in the same manner as the original.) Solder the pin on both sides of the circuit board. If the pin was bent at an angle to mate with a connector, bend the new pin to match the associated pins. The inside radius of this bend should not be less than 0.025 inch.

B. CIRCUIT BOARD PIN SOCKETS. The pin sockets on the circuit boards are soldered to the rear of the board. To replace the sockets, first unsolder the socket (use a vacuum-type desoldering tool to remove excess solder). Straighten the tabs on the socket to remove it from the hole in the circuit board. Place the new socket in the circuit board hole and press the tabs down against the board. Solder the socket tabs to the circuit board.

NOTE

The spring tension of the terminal sockets ensures a good connection between the circuit board and the pin. This spring tension can be destroyed by using the pin sockets as a connecting point for spring-loaded probe tips, alligator clips, etc.

C. END-LEAD PIN CONNECTORS. The pin connectors used to connect the wires to the circuit board pins are clamped to the ends of the associated leads. To replace a damaged pin connector, first remove the old pin connector from the end of the lead. Clamp the new pin connector to the end of the lead. Some of the pin connectors are grouped together and mounted in a plastic holder. These connectors are removed and re-installed as a unit. To provide correct orientation of this multi-connector when it is replaced, an arrow is stamped on the circuit board and a matching arrow is moulded into the plastic housing of the multi-pin connector.

Switch Replacement. Two types of switches are used in the Type 7B50. The pushbutton switches and the cam-type switch should be replaced as a unit if damaged. The following special maintenance information is provided for the cam-type and pushbutton type switches.

CAUTION

Repair of the cam switch should only be undertaken by skilled maintenance personnel. Switch alignment and contact spacing must be carefully maintained for proper operation of the switch. The cam switch repair kit contains special alignment tools for use in repairing or replacing the cam and contacts. For information or assistance on maintenance of the cam switch contact your local Tektronix Field Office or Representative.

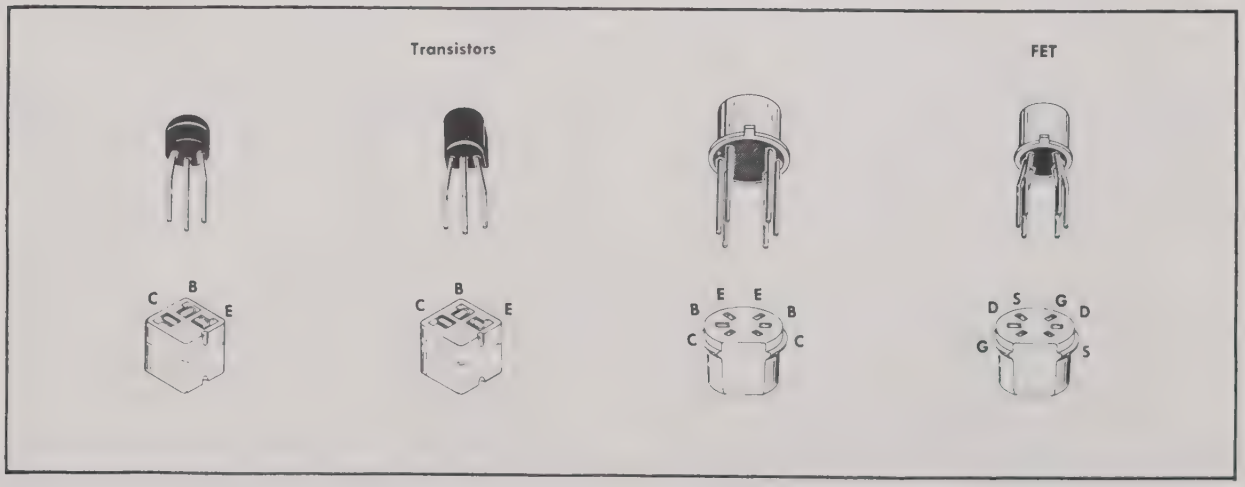


Fig. 4-3. Electrode configuration of transistors used in this instrument.

A. CAM-TYPE SWITCH. The cam-type switch (TIME/DIV) consists of a rotating cam, which is turned by the front panel knob, and a set of contacts mounted on an adjacent circuit board. These switch contacts are actuated by lobes on the cam. The TIME/DIV switch can be disassembled for inspection, cleaning, repair or replacement as follows:

1. Remove the four screws which hold the metal cover over the switch. The switch is now open for inspection or cleaning.

2. To completely remove the switch, loosen the set screw on the collar securing the VARIABLE shaft to the VARIABLE potentiometer and pull the shaft completely out the front of the unit. Loosen the two set screws on the TIME/DIV knob and remove the knob. Remove the plastic bushing from the access hole for the TIME/DIV shaft.

3. Remove the sweep generator board by loosening the four knurled screws and carefully lifting out.

4. Remove the six screws which hold the cam switch to the interface circuit board and remove the cam switch.

5. To remove the cam from the front support block, remove the retaining ring from the shaft on the front of the switch and slide the cam out of the support block. Do not lose the small detent roller.

6. To replace defective switch contacts, unsolder the damaged contact and clean the solder from the hole in the circuit board. Following the procedure given in the instruction sheet included with the cam switch replacement kit, use the alignment tool to position the new contact in place. Solder the contact using the soldering techniques given previously in this section of the manual.

7. To re-assemble the switch, reverse the above procedure.

B. PUSH-BUTTON SWITCHES. Use the following procedure to replace the five pushbutton switches:

1. Loosen the set screws and remove the POSITION, LEVEL/SLOPE, TIME/DIV, VARIABLE, and Amplifier VARIABLE knobs.

2. Remove the front panel to gain access to the switch mounting screws.

3. To remove the DISPLAY MODE switch, remove the phillips head screw and disconnect the multi-pin connector.

4. To remove the MAGNIFIER switch, remove the phillips head screw and disconnect the multi-pin connector.

5. To remove the TRIGGERING switches, remove the two phillips head screws from each of the MODE, COUPLING and SOURCE switches. Disconnect the following multi-pin connectors: AMPLIFIER VARIABLE, DISPLAY MODE, SWP CAL, POSITION, LEVEL/SLOPE, TRIG'D and MAGNIFIER. Disconnect the two pin connectors from the SOURCE and COUPLING switches. Remove the four screws securing the front of the unit to the top and bottom and remove the front of the unit. Remove the TRIGGERING switches (the sweep generator board may have to be removed to take out the TRIGGERING MODE switch).

Light Bulb Replacement. Two types of pushbutton switches which have different light designs are available. One switch type uses a metal cover over the light bulb(s) on the rear of the switch; the other type does not. Either or both types of switches may be used in the 7B50.

To replace light bulbs in the pushbutton switches with the metal cover, use the following replacement procedure, for switches without the metal cover, disregard steps pertaining to the cover.

To replace the light bulbs follow the above procedure to remove the switches. Remove the screw and cover from the back of the switch to expose the light bulb. Unsolder the two leads and remove the light bulb. Cut the leads of the replacement light bulb to the same length as those of the old bulb. Place insulating sleeves over the leads and replace the new bulb in the exact position of the old bulb.

Reassemble by reversing the above procedure.

Instrument Repackaging

If the Type 7B50 is to be shipped for long distances by commercial means of transportation, it is recommended that the instrument be repackaged in the original manner for maximum protection. The original shipping carton can be saved and used for this purpose. Repackaging information and/or new shipping cartons can be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative.

NOTE

The plug-ins should not be shipped installed in an oscilloscope. The oscilloscope packaging material is not designed to protect the plug-ins.

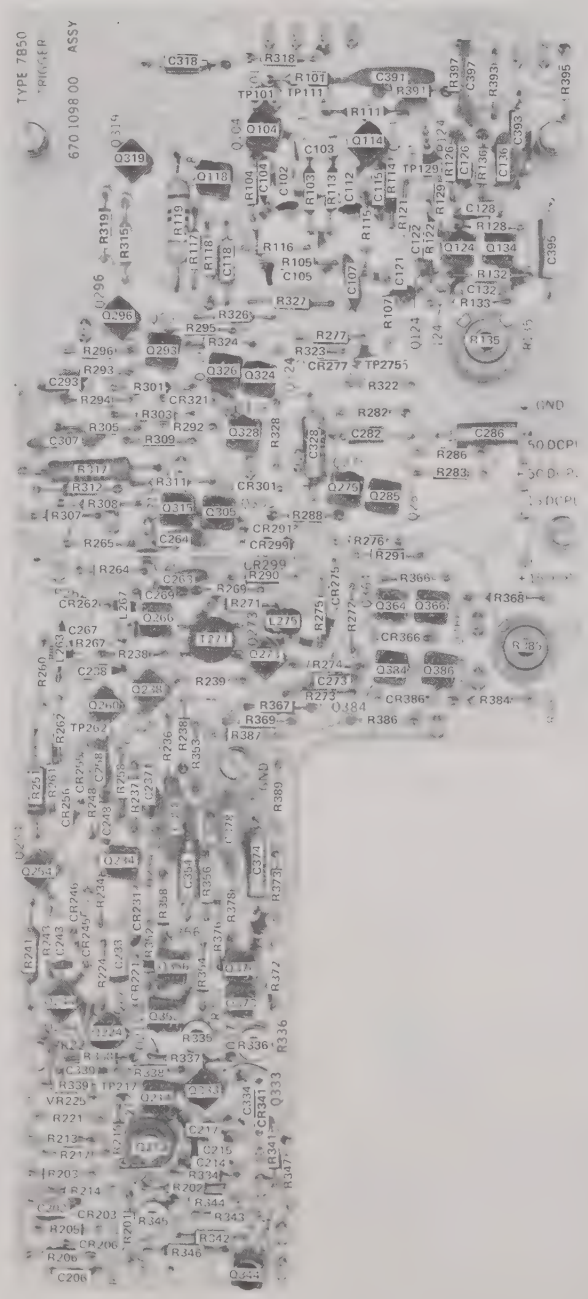


Fig. 4-4. Trigger generator board (front view) showing location of components.

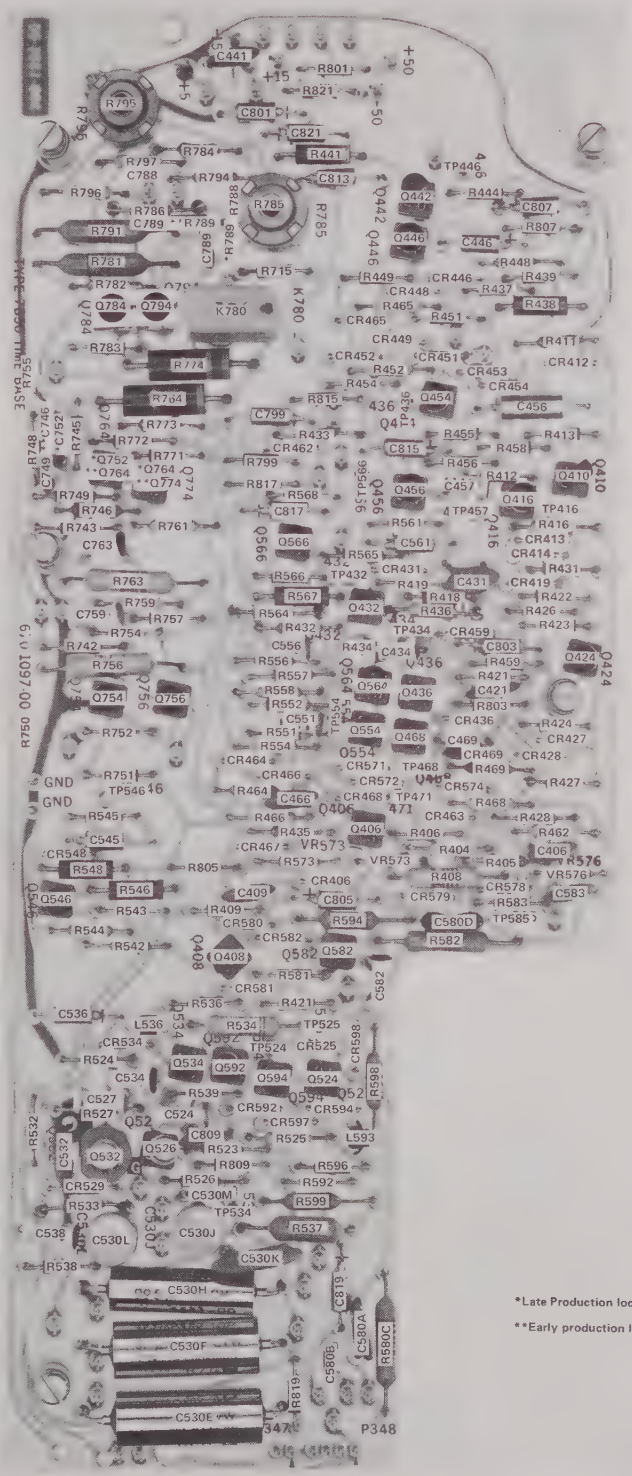


Fig. 4-5. Sweep generator board (front view) showing location of components.

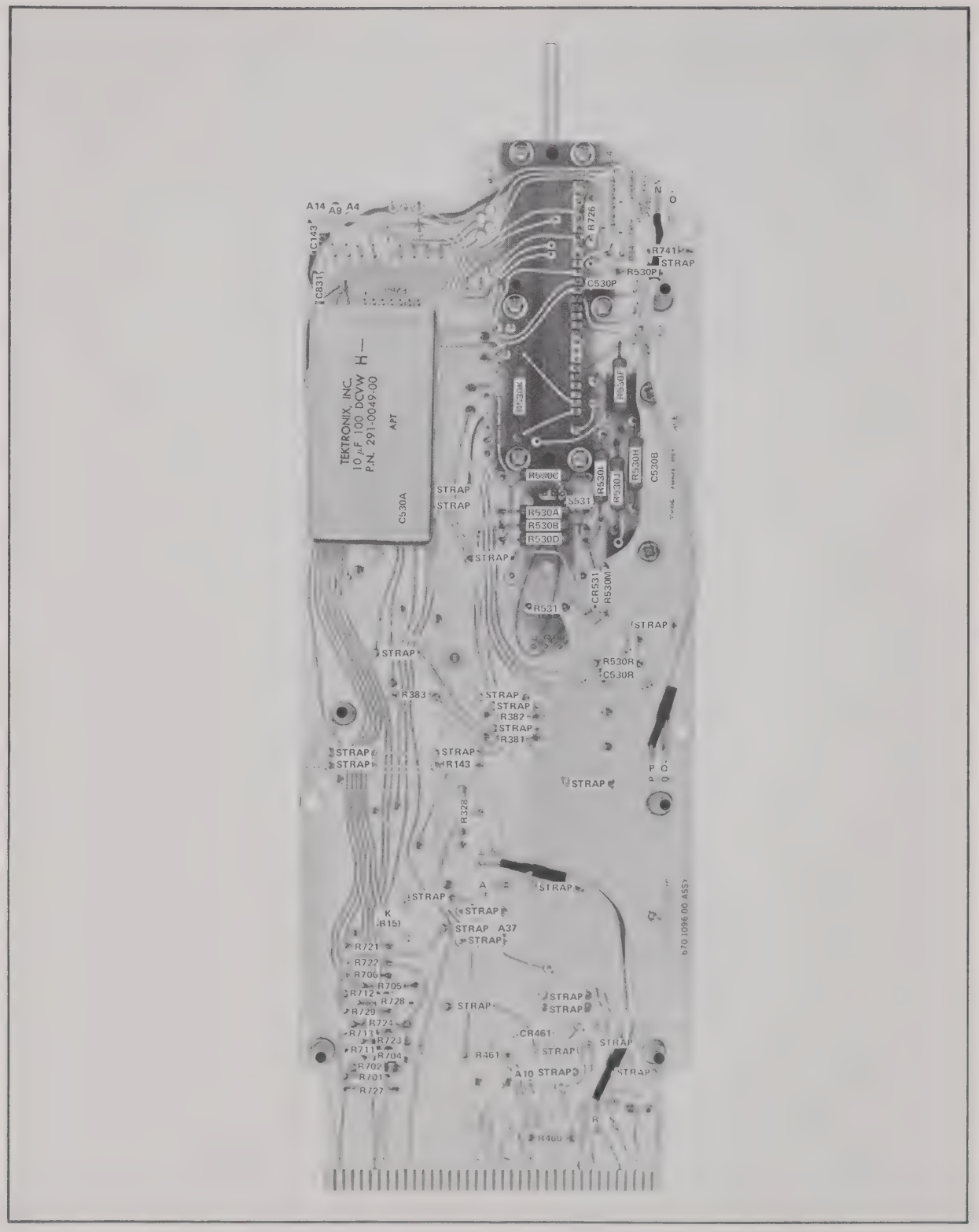


Fig. 4-6. Interface board (left side) showing location of components.

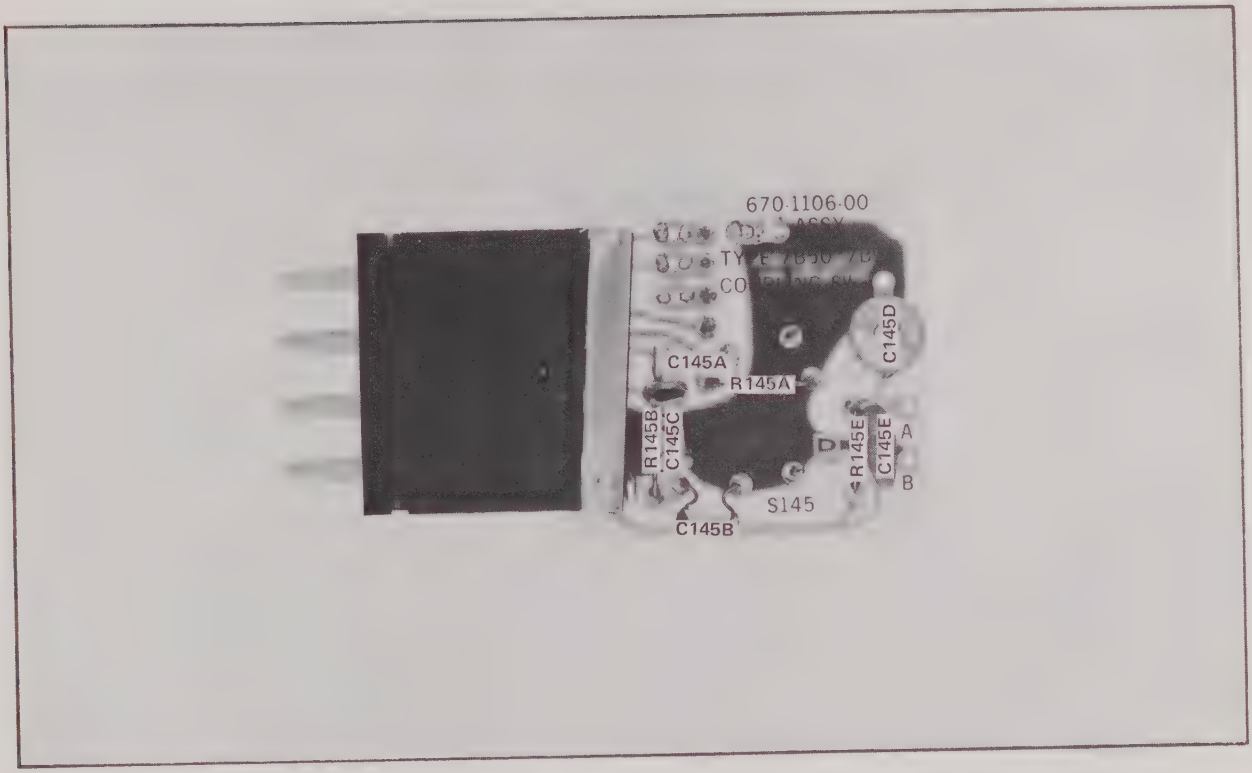


Fig. 4-7. Coupling switch board showing location of components.

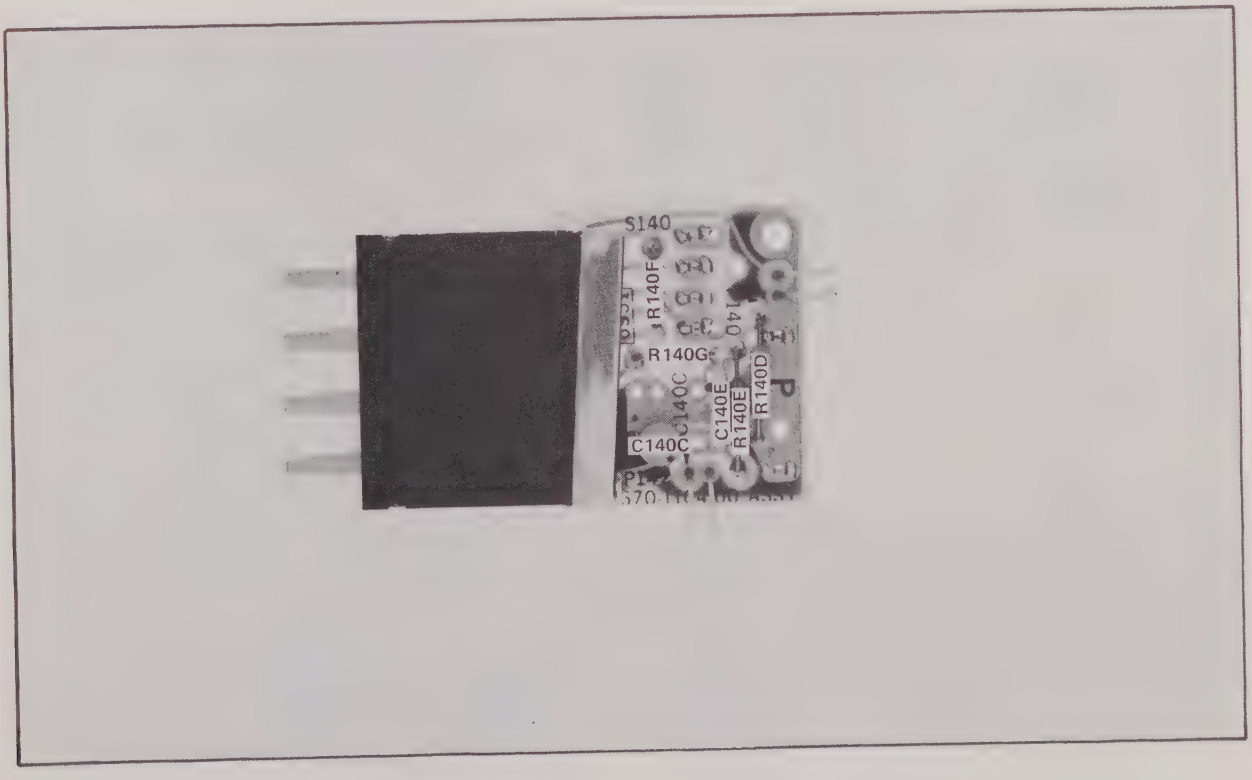


Fig. 4-8. Source switch board showing location of components.

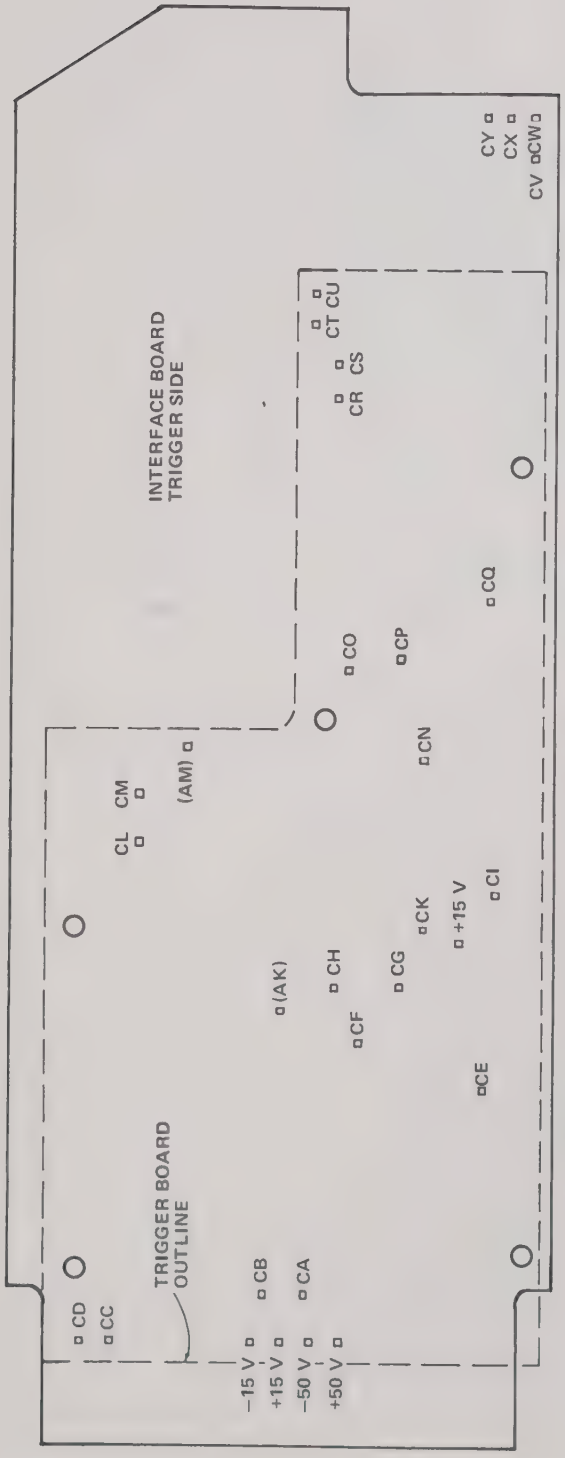


Fig. 4-9. Interface board (right side) showing location of square pin connectors.

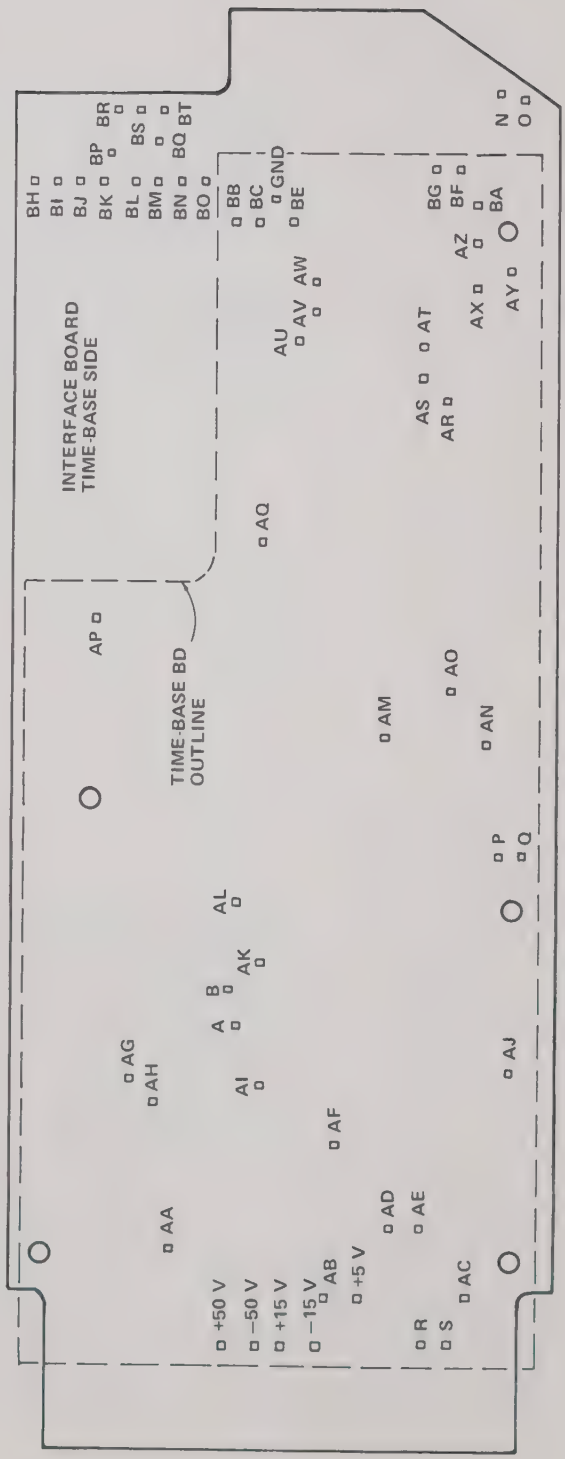


Fig. 4-10. Interface board (left side) showing location of square pin connectors.

SECTION 5
PERFORMANCE CHECK CALIBRATION PROCEDURE

Change information, if any, affecting this section will be found at the rear of the manual.

Introduction

To assure instrument accuracy, check the calibration of the Type 7B50 every 1000 hours, or every six months if used infrequently. Before calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance Section.

The complete Performance Check/Calibration Procedure can be used to check instrument performance without removing side covers or making internal adjustments, by performing all portions except the ADJUST part of the steps. Screwdriver adjustments which are accessible without removing the covers are adjusted as part of the performance check procedure. A note titled PERFORMANCE CHECK ONLY gives instructions which are applicable only to the performance check procedure.

Completion of each step in the complete Performance Check/Calibration Procedure insures that this instrument meets the electrical specifications given in Section 1. For best overall instrument performance, when performing a complete calibration procedure, make each adjustment to the exact setting even if the CHECK is within the allowable tolerance.

A Short-Form Procedure is given prior to the complete procedure. To facilitate instrument calibration for the experienced calibrator, the Short-Form Procedure lists the calibration adjustment necessary for each step and the applicable tolerances. This procedure also includes the step number and title as listed in the complete Performance Check/Calibration Procedure and the page number on which each step begins. Thus, the Short-Form Procedure can be used as an index to locate a step in the complete procedure. Another feature of the Short-Form Procedure is the spaces provided to record performance data or to check off steps as they are completed. This procedure may be reproduced and used as a permanent record of instrument calibration.

NOTE

All waveforms shown in this procedure were taken with a Tektronix Oscilloscope Camera System. Limits, tolerances and waveforms in this procedure are given as calibration guides and should not be interpreted as instrument specifications except as specified in Section 1.

A partial calibration is often desirable after replacing a component or to touch up an adjustment of a portion of the instrument between major recalibrations. For partial calibration, set the controls as given under Preliminary Control Setting and start with the nearest test equipment picture preceding the desired check or checks. If any controls need to be changed from the preliminary settings for this portion of the calibration procedure, they are listed under the heading Partial Procedure, following the equipment required picture. To prevent unnecessary recalibration of other parts of the instrument, readjust only if the tolerance given in the CHECK part of the step is not met. If readjustment is necessary, also check the calibration of any steps listed in the INTERACTION part of the step.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or its equivalent, are required for complete calibration of the Type 7B50. Specifications given are the minimum necessary for accurate calibration. Therefore, some of the recommended equipment may have specifications which exceed those given. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

Special Tektronix calibration fixtures are used in this procedure only where they facilitate calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

1. Test time-base having delaying sweep capabilities and compatible with the Tektronix 7000-series oscilloscope. Type 7B50 used in these checks.

2. Vertical amplifier for use with Tektronix 7000-series oscilloscopes. Bandwidth, 100 MHz or greater; deflection factor, 5 volts to 5 millivolts. Tektronix Type 7A16 used in these checks.

3. Oscilloscope. Tektronix Type 7504 or Type 7704.

4. Plug-in extender. Tektronix Part Number 067-0589-00.

5. Low-frequency sine-wave generator. Frequency range, 20 hertz to greater than 50 kilohertz; output amplitude, 150 millivolts to 5 volts. For example, General Radio Model 1310-A Oscillator.

6. Constant amplitude sine-wave generator. Reference frequency, 50 kilohertz; frequency range, 10 megahertz to 100 megahertz; output amplitude variable from 150 millivolts to 5 volts. Tektronix Type 191 recommended.

7. Time-mark generator. Marker outputs, five seconds to five nanoseconds; marker accuracy, within 0.1%. Tektronix Type 184 Time-Mark Generator recommended.

8. Square-wave generator. Frequency, one kilohertz. Risetime, 20 nanoseconds or less at 0.5 volts. Tektronix Type 106 Square-Wave Generator recommended.

9. 10X probe with BNC connector. Tektronix Type P6053 recommended.

10. Input RC Normalizer. Time constant 1 megohm X 20 picofarads; connectors, BNC. Tektronix calibration fixture 067-0538-00.

11. Cable (two each). Connectors, BNC; Impedance, 50 ohms; length, 42 inches. Tektronix part number 012-0057-01.

12. BNC T connector, Tektronix Part Number 103-0030-00.

13. 10X attenuator, Tektronix Part Number 011-0059-01.

14. 50 ohm feedthrough termination, Tektronix Part Number 011-0049-01.

15. Adapter, GR to BNC female. Tektronix Part Number 017-0063-00.

SHORT-FORM PROCEDURE

Type 7B50 _____

Calibration Date _____

Calibrated By _____

1. Check/Adjust Level Center (R385) Page 5-4

Requirement: Stable triggering on both the positive slope and negative slope of the signal.

Performance: Correct ____ ; Incorrect ____ .

2. Check/Adjust P-P Auto Level Range (R335-R336) Page 5-5

Requirement: A triggered display is obtained throughout 360° rotation of the LEVEL/SLOPE control with a six division signal applied.

Performance: Correct ____ ; Incorrect ____ .

3. Check/Adjust Internal Trigger Centering (R135) Page 5-5

Requirement: With a 50 kHz sine-wave centered vertically on the CRT, check that the trigger point remains fixed as the Type 7A16 POSITION control is moved.

Performance: Correct ____ ; Incorrect ____ .

4. Check Level/Slope Range Page 5-6

Requirement: Triggering over the complete range of a +3.5 volt to −3.5 volt input signal.

Performance: Correct ____ ; Incorrect ____ .

5. Adjust External Trigger Input Compensation (C145D, C140C) Page 5-6

Requirement: With a 1 kHz square-wave applied to the EXT TRIG IN connector, adjust for best square corner.

Performance: Correct ____ ; Incorrect ____ .

6. Check Trigger Bandwidth Page 5-6

Requirement: Trigger bandwidth meets the specifications given in Section 1. Refer to the complete procedure.

Performance: Correct ____ ; Incorrect ____ .

7. Check Sweep Jitter Page 5-7

Requirement: No more than 0.2 division of jitter with TIME/DIV set to 5 ns and a 75 MHz signal applied.

Performance: Correct _____ ; Incorrect _____ .

8. Check Trigger Modes Page 5-7

Requirement: Correct triggering in all modes. Refer to complete procedure.

Performance: Correct _____ ; Incorrect _____ .

9. Check/Adjust Sweep Calibration (SWP CAL, a front-panel adjust) Page 5-8

Requirement: With TIME/DIV at 1 ms and 1 ms markers applied, check for one marker for each division. The second and tenth markers must line up exactly with their respective graticule lines.

Performance: Correct _____ ; Incorrect _____ .

10. Check/Adjust Magnified Sweep Gain (R785) Page 5-8

Requirement: With TIME/DIV at 1 ms and MAGNIFIER at X10, apply 0.1 ms markers. Check for 1 marker for each division between the second and tenth vertical lines.

Performance: Correct _____ ; Incorrect _____ .

11. Check/Adjust Magnifier Register (R795) Page 5-9

Requirement: No shift of display when switching MAGNIFIER between X1 and X10.

Performance: Correct _____ ; Incorrect _____ .

12. Check Sweep Length Page 5-9

Requirement: Sweep length must be between 10 and 13 divisions.

Performance: Correct _____ ; Incorrect _____ .

13. Check Variable Time/Div Page 5-9

Requirement: Continuously variable between calibrated settings of the TIME/DIV switch.

Performance: Correct _____ ; Incorrect _____ .

14. Check/Adjust 5 µs Timing (C530J) Page 5-10

Requirement: With 5 µs markers applied and TIME/DIV set to 5 µs, check for one marker each division. The second and tenth markers must line up with their respective graticule lines.

Performance: Correct _____ ; Incorrect _____ .

15. Check/Adjust 0.2 µs Timing (C530L) Page 5-10

Requirement: With .1 µs markers applied and TIME/DIV set to .2 µs, check for two markers each division. The first and ninth markers must line up with their respective graticule lines.

Performance: Correct _____ ; Incorrect _____ .

16. Check Sweep Timing Accuracy Page 5-10

Requirement: Sweep timing accuracy over the center eight division must be within 2% from .05 µs/Div to .5 s/Div and within 3% from 1 s/Div to 5 s/Div.

Performance: Correct _____ ; Incorrect _____ (list any discrepancies) _____ .

17. Check Magnified Sweep Timing Page 5-11

Requirement: Magnified sweep timing accuracy over the center eight divisions must be within 2.5% from .05 µs/Div to .5 s/Div and within 3.5% from 1 s/Div to 5 s/Div.

Performance: Correct _____ ; Incorrect _____ (list any discrepancies) _____ .

18. Check Sweep Inhibit Page 5-11

Requirement: The intensified portion may be positioned to any part of the sweep.

Performance: Correct _____ ; Incorrect _____ .

19. Check Amplifier VARIABLE Range Page 5-11

Requirement: 10 to 1 ratio from fully clockwise to fully counterclockwise.

Performance: Correct _____ ; Incorrect _____ .

20. Check/Adjust External Horizontal Center (R345) Page 5-12

Requirement: No horizontal movement of trace as VARIABLE control is rotated.

Performance: Correct ____ ; Incorrect ____ .

21. Check Amplifier Deflection Factor Page 5-12

Requirement: 90 millivolts/division ±10 millivolts in EXT and 900 millivolts/division ±110 millivolts in EXT ÷ 10.

Performance: Correct ____ ; Incorrect ____ .

22. Check Amplifier Bandwidth Page 5-12

Requirement: Meets Specifications given in Section 1 of this manual. See complete procedure.

Performance: Correct ____ ; Incorrect ____ (list any discrepancies) _____ .

PERFORMANCE CHECK/CALIBRATION PROCEDURE

General

The following procedure is arranged so the Type 7B50 can be calibrated with the least interaction of adjustments and reconnection of equipment. A picture of the test equipment required for each group of steps is given to aid in identification of the necessary equipment. The control settings continue from the preceding step(s) unless noted otherwise.

The following procedure uses the equipment listed under Test Equipment Required. If other equipment is substituted, control settings or calibration setup may need to be altered to meet the requirements of the equipment used. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is required.

NOTE

This instrument should be calibrated to an ambient temperature of +25°C ±10°C for best overall accuracy. If the temperature is outside the given range, see Section 1 for the applicable tolerances.

Preliminary Control Settings

Type 7B51
(A horizontal plug-in compartment)

Level/Slope	0/+
Triggering	
Mode	P-P Auto
Coupling	AC
Source	Int
Position	Midrange
Magnifier	X1
B Delay Mode	Independent
Time/div	.1 ms
Variable	Cal In

Type 7B50
(B horizontal plug-in compartment)

LEVEL/SLOPE	0/+
TRIGGERING	
MODE	NORM
COUPLING	AC
SOURCE	EXT
POSITION	MIDRANGE
MAGNIFIER	X1
DISPLAY MODE	TIME BASE
TIME/DIV	20 µs
VARIABLE	CAL IN
AMPLIFIER VARIABLE	Fully Clockwise

Type 7A16
(Left vertical plug-in compartment)

AC-GND-DC	DC
Volts/div	.5 V
Position	Midrange
Polarity	+ UP

Type 7504 Indicator Oscilloscope

A Intensity	CCW
B Intensity	CCW
Vertical Mode	Left
Horizontal Mode	A
A Trigger Source	Left Vert
B Trigger Source	Left Vert

Turn the indicator oscilloscope power on and advance the A Intensity until a free-running trace is observed. Center the trace on the CRT with the horizontal and vertical POSITION controls and allow several minutes warmup before proceeding with calibration.

CALIBRATION PROCEDURE

1. Check/Adjust Level Center (R385)

a. Test equipment required is shown in Fig. 5-1.

b. Connect a BNC "T" connector to the output of the low-frequency sine-wave generator. Using two 50 Ω BNC coaxial cables, connect the Type 7A16 Input and the Type 7B50 EXT TRIG IN to the "T" connector.

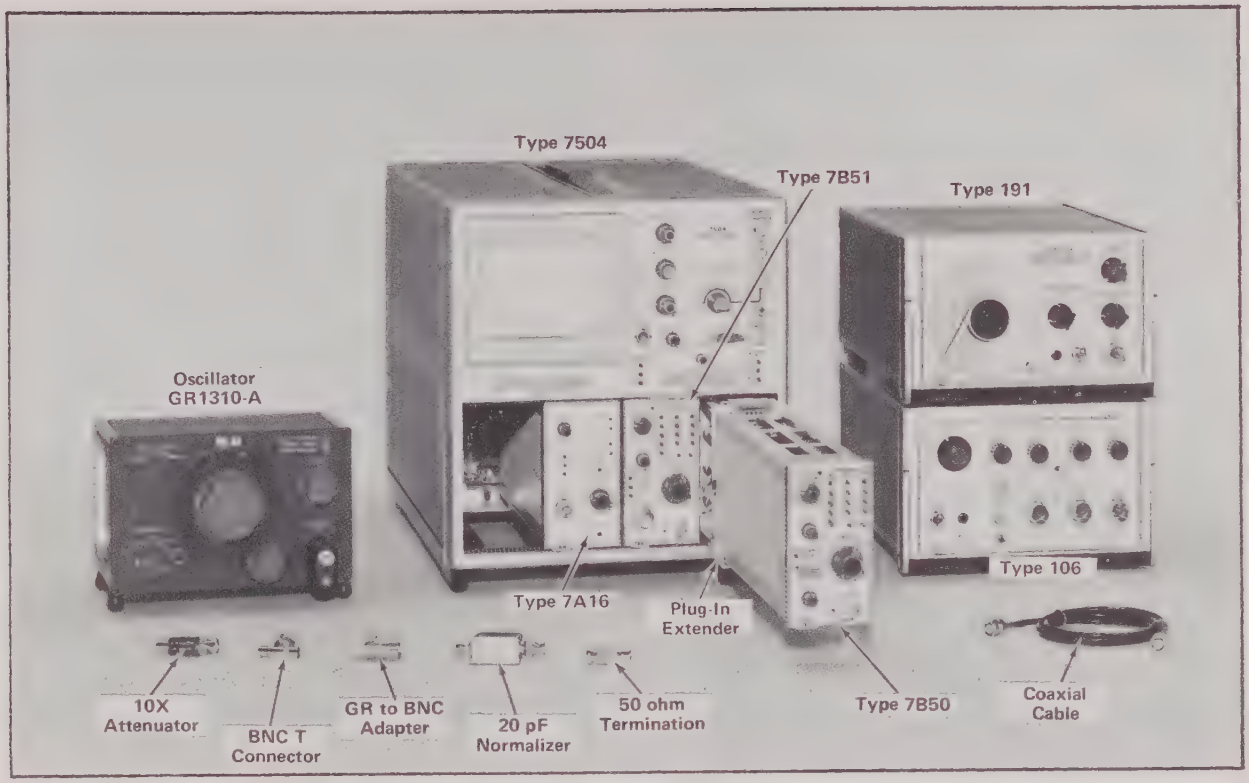


Fig. 5-1. Test equipment required for steps 1 through 8.

c. Set the sine-wave generator to 50 kHz and adjust the amplitude for a 0.3 division (150 mV) display on the CRT.

d. Reset the indicator oscilloscope Horizontal Mode to B and advance the B Intensity.

e. CHECK—For a stable display triggered on the positive slope of the signal.

f. ADJUST—R385 for a stable display triggered on the positive slope of the signal.

g. Reset the Type 7B50 LEVEL/SLOPE to 0/—.

h. CHECK—For a stable display triggered on the negative slope of the signal.

NOTE

Slight readjustment of R385 may be necessary. Alternate between 0/+ and 0/— while adjusting R385 for optimum triggering on both the positive and negative slopes of the signal.

2. Check/Adjust P-P AUTO LEVEL Range (R335-R336)

a. Reset the Type 7B50 TRIGGERING MODE to P-P AUTO. Increase the sine-wave generator output to display a six division signal.

b. CHECK—A triggered display is obtained throughout 360° rotation of the LEVEL/SLOPE control.

c. ADJUST—R335 for a triggered display as the LEVEL/SLOPE control is rotated from 0/+ clockwise through top center to 0/—.

d. ADJUST—R336 for a triggered display as the LEVEL/SLOPE control is rotated from 0/+ counterclockwise through bottom center to 0/—.

3. Check/Adjust Internal Trigger Centering (R135)

a. Reset the Type 7B50 TRIGGERING MODE to NORM, COUPLING to DC, SOURCE to INT and LEVEL/SLOPE to 0/+.

b. Center the 50 kHz sinewave vertically on the CRT so the display extends an equal distance above and below the center horizontal line.

c. CHECK—The trigger point is at the center horizontal line.

d. ADJUST—R135 to move the trigger point to the center horizontal line.

e. CHECK—Change the Type 7A16 Position control and check that the trigger point remains fixed at the center horizontal line.

4. Check Level/Slope Range

a. Change the control settings as follows:

Type 7A16	
Volts/div	1 V
Type 7B50	
TRIGGERING	
COUPLING	AC
SOURCE	EXT

b. Set the low-frequency sine-wave generator to 50 kHz and adjust the amplitude for a seven division display on the CRT.

c. CHECK—Rotate the LEVEL/SLOPE control and check that all levels of the display may be selected as the sweep trigger point. Check for no trigger (no display) with the LEVEL/SLOPE control near the top and near the bottom.

5. Adjust External Trigger Input Compensation (C145D, C140C)

a. Disconnect the sine-wave generator and change the control settings as follows:

Type 7A16	
Volts/div	.1 V
Type 7B50	
TIME/DIV	1 ms
TRIGGERING	
COUPLING	DC
MODE	AUTO
SOURCE	INT

b. Connect a 1 kHz square wave from the Type 106 Hi-Amplitude output through a GR to BNC female adapter, a BNC coaxial cable, a 10X attenuator, a 50 ohm termination and a 20 pF normalizer to the Type 7A16 input. Adjust the Type 106 amplitude for a five division display.

c. Reset the Type 7B50 SOURCE to EXT. Connect the 1 kHz signal through the 10X attenuator, 50 ohm termination and 20 pF normalizer to the Type 7B50 EXT TRIG IN.

d. Connect a 10X probe from the Type 7A16 input to TP 217 (Type 7B50 trigger generator board).

e. ADJUST—C145D (located on COUPLING switch board) for best square corner on the square wave.

f. Remove the 10X attenuator and change the TRIGGERING SOURCE to EXT ÷ 10.

g. ADJUST—C140C (located on SOURCE switch board) for best square corner on the square wave.

h. Remove the square-wave input to the Type 7B50.

6. Check Trigger Bandwidth

a. Change the control settings as follows:

Type 7A16	
Volts/Div	.5 V
Type 7B50	
TRIGGERING	
MODE	P-P AUTO
COUPLING	AC
SOURCE	INT
TIME/DIV	10 ms

b. Connect a 30 Hz sine wave from the low-frequency sine-wave generator through a "T" connector and coaxial cables to the Type 7A15 input and the Type 7B50 EXT TRIG IN. Adjust the sine-wave amplitude for a 0.3 division display. Reset the Type 7B50 TRIGGERING MODE to NORM.

c. CHECK—Stable triggering can be obtained with the LEVEL/SLOPE control at 0/+ and 0/—. Check that the TRIG'D lamp is lit.

d. CHECK—Using the control settings in Table 5-1, check for stable triggered and a lighted TRIG'D lamp for each condition listed. Maintain a 0.3 division display, except as noted. Use the Type 7B50 TIME/DIV control as necessary for optimum viewing of display.

TABLE 5-1

Type 7B50 COUPLING	SOURCE	Sine-Wave Gen. Frequency	Stable Triggering	TRIG'D lamp lighted
AC	INT	30 Hz	yes	yes
AC	EXT	30 Hz	yes	yes
AC HF REJ	EXT	30 Hz	yes	yes
AC HF REJ	INT	30 Hz	yes	yes
DC	INT	30 Hz	yes	yes
DC	EXT	30 Hz	yes	yes
AC LF REJ	INT	30 kHz	yes	yes
AC HF REJ	INT	50 kHz	yes	yes
AC HF REJ	EXT	50 kHz	yes	yes
AC LF REJ	EXT	150 kHz	yes	yes
AC LF REJ	EXT	120 Hz	no trigger with 1.5 V	

e. Change the "T" connector from the low-frequency sine-wave generator to the Type 191 signal generator output connector (using a GR to BNC adapter). Set the Type 191 to 10 MHz and adjust the amplitude for a 0.3 division (150 mV) display.

f. CHECK—Using the control settings in Table 5-2, check for stable triggering and that the TRIG'D lamp is lighted for each condition listed. Note that the Type 191 amplitude is increased at 100 MHz.

7. Check Sweep Jitter

a. Set the Type 191 to 75 MHz. Set the Type 7B50 TIME/DIV to .05 µs and MAGNIFIER to X10.

b. CHECK—For no more than 0.2 div (1 ns) of jitter. Disregard any slow drift.

8. Check Trigger Modes

a. Change the control settings as follows:

	Type 7B50
TIME/DIV	.1 µs
TRIGGERING	
MODE	P-P AUTO
COUPLING	AC
SOURCE	INT

b. Set the Type 191 to 50 MHz and adjust the amplitude for a four division display.

c. CHECK—Turn the LEVEL/SLOPE control throughout its range and check for proper triggering at all positions. Remove the signal from the Type 7A16 and check for a free-running trace.

d. Reset the Type 7B50 TRIGGERING MODE to AUTO. Reconnect the 50 MHz signal to the Type 7A16.

e. CHECK—For proper triggering with the LEVEL/SLOPE control at 0/+ and 0/—. Check for a free-running display with the LEVEL/SLOPE control near the top and near the bottom.

TABLE 5-2

Type 7B50 COUPLING	SOURCE	Type 191 frequency	Amplitude	Stable Triggering	TRIG'D lamp
DC	EXT	10 MHz	0.3 div	yes	yes
DC	INT	10 MHz	0.3 div	yes	yes
AC LF REJ	INT	10 MHz	0.3 div	yes	yes
AC LF REJ	EXT	10 MHz	0.3 div	yes	yes
AC	EXT	10 MHz	0.3 div	yes	yes
AC	INT	10 MHz	0.3 div	yes	yes
AC	INT	100 MHz	1.5 div	yes	yes
AC	EXT	100 MHz	1.5 div	yes	yes
AC LF REJ	EXT	100 MHz	1.5 div	yes	yes
AC LF REJ	INT	100 MHz	1.5 div	yes	yes
DC	INT	100 MHz	1.5 div	yes	yes
DC	EXT	100 MHz	1.5 div	yes	yes

f. Reset the Type 7B50 TRIGGERING MODE to NORM.

g. CHECK—For proper triggering with the LEVEL/SLOPE control at 0/+ and 0/—. Check for no trace with the LEVEL/SLOPE control near the top and near the bottom.

h. Reset the Type 7B50 TIME/DIV to 50 µs and MAGNIFIER to X1. Set the Type 191 to 50 kHz and adjust the amplitude for a four division display. Adjust the Type 7B50 LEVEL/SLOPE for a stable display. Reset the TRIGGERING MODE to SINGLE SWEEP.

i. CHECK—Remove the signal from the Type 7A16. Press the Type 7B51 RESET button and check that the READY lamp is lighted. While observing the display, reconnect the signal to the Type 7A16 and check for one displayed sweep (it may be necessary to increase the INTENSITY to observe the display). Check that the READY lamp is out at the end of the sweep.

j. Reset the Type 7B50 TRIGGERING MODE to P-P AUTO and SOURCE to EXT. Adjust the Type 191 for a 1.5 division (750 mV) display.

k. CHECK—Rotate the LEVEL/SLOPE throughout its range and check for stable triggering at all positions.

l. Change the "T" connector from the Type 191 to the low-frequency sine-wave generator output connector.

m. Set the Type 7B50 TRIGGERING COUPLING to DC and SOURCE to INT. Set the Time/Div to 10 ms.

n. Set the low-frequency sine-wave generator to 50 Hz and adjust the amplitude for a 2 division display.

o. CHECK—A stable display can be obtained.

p. Remove the 50 Hz signal from the Type 7A16 and Type 7B50.

9. Check/Adjust Sweep Calibration (SWP CAL, a front-panel adjustment)

a. Reset the Type 7B50 TIME/DIV to 1 ms and COUPLING to AC.

b. Apply 1 ms markers from the Type 184 time-mark generator to the Type 7A16 Input.

c. CHECK—CRT display for one 1 ms marker for each division between the second and tenth vertical lines (see Fig. 5-2).

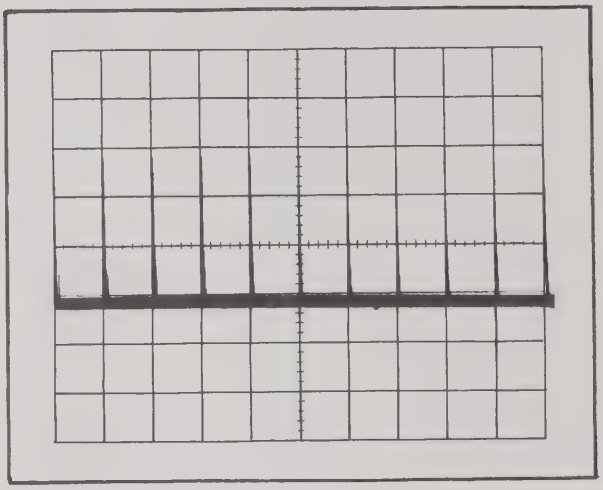


Fig. 5-2. Typical CRT display showing correct sweep calibration.

NOTE

Unless otherwise noted, use the center eight horizontal divisions when checking or adjusting timing.

d. ADJUST—SWP CAL, a front-panel adjustment, for one marker for each division. The second and tenth markers must line up exactly with their respective graticule lines (use the horizontal POSITION control as necessary to line up the display).

e. CHECK—Timing accuracy is within 5% over any two division interval within the center eight divisions.

f. INTERACTION: Check 10, 11, 13, 14, 15, 16 and 17.

10. Check/Adjust Magnified Sweep Gain (R785)

a. Set the time-mark generator for .1 ms markers.

b. Set the Type 7B50 MAGNIFIER to X10.

c. CHECK—CRT display for one .1 ms marker for each division between the second and tenth vertical lines.

d. ADJUST—R785, Magnifier Gain, for one marker for each division (use the horizontal POSITION control as necessary to line up the display).

e. CHECK—Timing accuracy is within 5% over any two division interval within the center eight divisions.

f. INTERACTION: Check steps 11 and 17.

11. Check/Adjust Magnifier Registration (R795)

a. Set the time-mark generator for 5 ms markers.

b. Position the middle marker to the center vertical line (there are three markers on the total magnified sweep) with the horizontal POSITION control. See Fig. 5-3A.

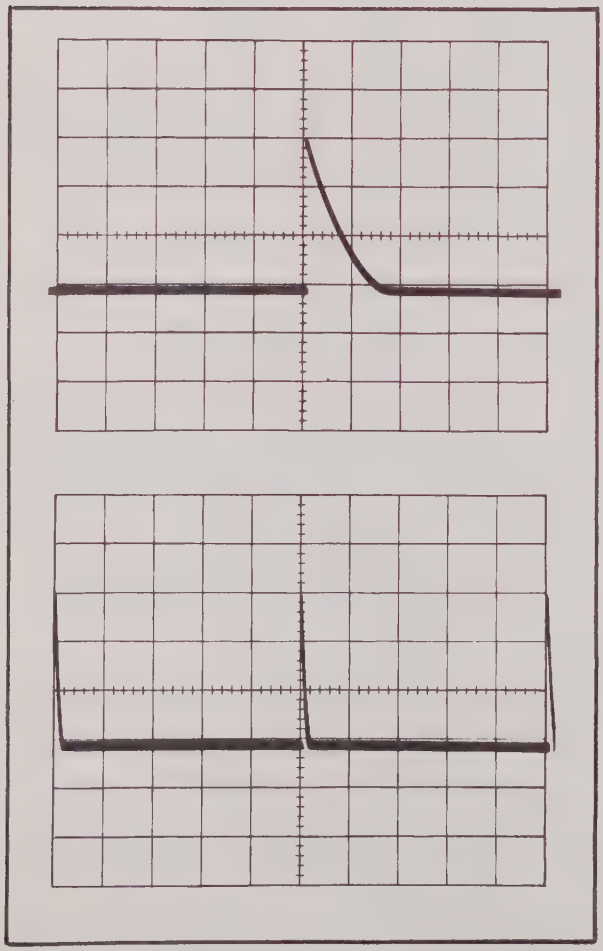


Fig. 5-3. Typical CRT display showing correct magnifier registration. (A) MAGNIFIER set to X10, (B) MAGNIFIER set to X1.

c. Set the MAGNIFIER to X1.

d. CHECK—Middle marker remains at the center vertical line. See Fig. 5-3B.

e. ADJUST— R795, Mag Regis, to position the middle marker to the center vertical line.

f. Alternately switch the MAGNIFIER between X1 and X10 and repeat steps b through e until no shift occurs when switching.

12. Check Sweep Length

a. Set the time-mark generator for 1 ms and .1 ms markers. Reset the MAGNIFIER to X1. Set the TRIGGERING MODE to AUTO.

b. Move the eleventh 1 ms marker to the center vertical line with the horizontal POSITION control (see Fig. 5-4).

c. CHECK—Sweep length must be between 10 and 13 divisions.

13. Check Variable Time/Div

a. Reset the Type 7B50 TIME/DIV to 2 ms. Set the time-mark generator for 10 ms markers.

b. Press and release the VARIABLE TIME/DIV knob and turn fully counterclockwise.

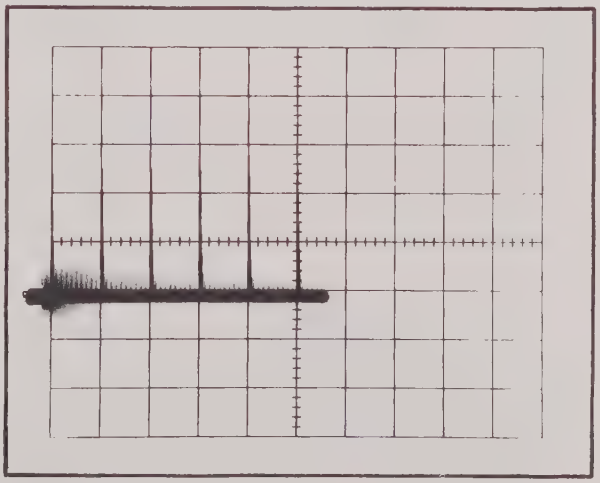


Fig. 5-4. Typical CRT display when checking sweep length.

c. CHECK—CRT display for two-division maximum spacing between markers (indicates adequate range for continuously variable sweep rate between the calibrated steps; see Fig. 5-5). Return the VARIABLE TIME/DIV to the CAL IN position.

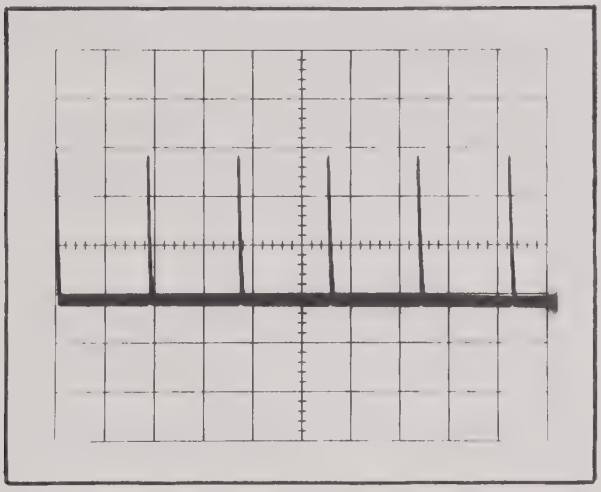


Fig. 5-5. Typical CRT display when checking VARIABLE control range.

14. Check/Adjust 5 μs Timing (C530J)

a. Set the time-mark generator for 5 μs markers.

b. Reset the Type 7B50 TIME/DIV to 5 μs, TRIGGERING MODE to AUTO, and adjust the LEVEL/SLOPE for a stable display.

c. CHECK—CRT display for one marker each division between the second and tenth vertical lines. Check that sweep timing is within 0.16 division (2%) over the center eight divisions. See Fig. 5-6.

d. ADJUST—C530J for one marker each division. The second and tenth markers must coincide exactly with their respective graticule lines (use the horizontal POSITION control as necessary to line up display).

15. Check/Adjust 0.2 μs Timing (C530L)

a. Set the time-mark generator for .1 μs markers.

b. Reset the Type 7B50 TIME/DIV to .2 μs.

c. CHECK—CRT display for two markers each division over the center eight divisions. Check that sweep timing is within 0.16 division (2%) over center eight divisions. See Fig. 5-7.

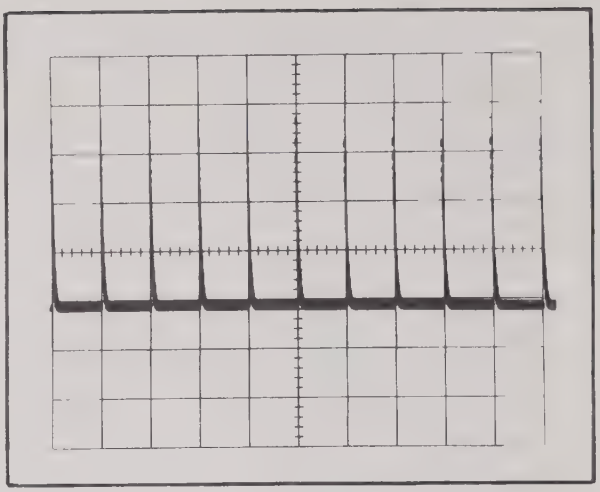


Fig. 5-6. CRT display showing correct 5 μs timing.

d. ADJUST—C530L for two markers each division. The markers at the second and tenth vertical lines must coincide exactly with their respective graticule lines (use the horizontal POSITION control as necessary to line up the display).

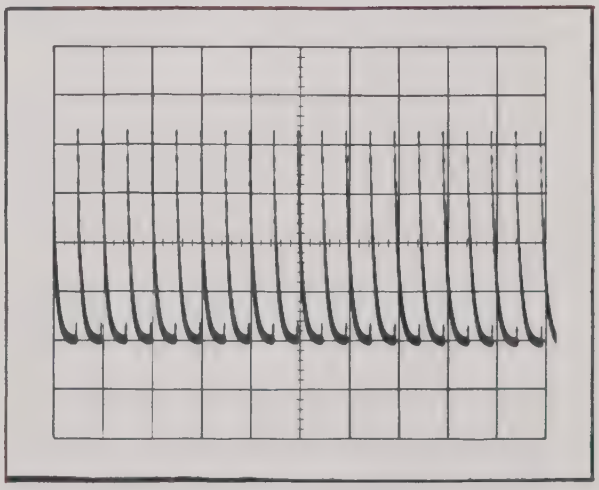


Fig. 5-7. CRT display showing correct .2 μs timing.

16. Check Sweep Timing Accuracy

a. Using the TIME/DIV and time-mark generator settings given in Table 5-3, check that sweep timing accuracy over the center eight divisions of the display is within allowable limits.

TABLE 5-3

Type 7B50 TIME/DIV	Type 184 Markers	Markers/ Div	Allowable Error
.05 µs	50 ns	1	±0.16 div
.1 µs	.1 µs	1	±0.16 div
.2 µs	.1 µs	2	±0.16 div
.5 µs	.5 µs	1	±0.16 div
1 µs	1 µs	1	±0.16 div
2 µs	1 µs	2	±0.16 div
5 µs	5 µs	1	±0.16 div
10 µs	10 µs	1	±0.16 div
20 µs	10 µs	2	±0.16 div
50 µs	50 µs	1	±0.16 div
.1 ms	.1 ms	1	±0.16 div
.2 ms	.1 ms	2	±0.16 div
.5 ms	.5 ms	1	±0.16 div
1 ms	1 ms	1	±0.16 div
2 ms	1 ms	2	±0.16 div
5 ms	5 ms	1	±0.16 div
10 ms	10 ms	1	±0.16 div
20 ms	10 ms	2	±0.16 div
50 ms	50 ms	1	±0.16 div
.1 s	.1 s	1	±0.16 div
.2 s	.1 s	2	±0.16 div
.5 s	.5 s	1	±0.16 div
1 s	1 s	1	±0.24 div
2 s	1 s	2	±0.24 div
5 s	5 s	1	±0.24 div

17. Check Magnified Sweep Timing

a. Set the Type 7B50 Magnifier to X10.

b. CHECK—Using the TIME/DIV and time-mark generator settings given in Table 5-4, check that sweep timing accuracy over the center eight divisions is within the allowable limits.

c. Reset the MAGNIFIER to X1.

18. Check Sweep Inhibit

a. Set the time-mark generator for 1 ms markers.

b. Set the Type 7B50 TRIGGERING MODE to NORM, TIME/DIV to 50 µs and adjust the LEVEL/SLOPE control for a triggered sweep.

c. Reset the Type 7504 Horizontal Mode to A; set the Test Time-Base Triggering Mode to Norm, Time/div to 1 ms and adjust Level Slope control for a triggered display.

TABLE 5-4

Type 7B50 TIME/DIV	Type 184 Markers	Markers Div	Allowable Error
5 s	.5 s	1	±0.28 div
2 s	.1 s	2	±0.28 div
1 s	.1 s	1	±0.28 div
.5 s	50 ms	1	±0.2 div
.2 s	10 ms	2	±0.2 div
.1 s	10 ms	1	±0.2 div
50 ms	5 ms	1	±0.2 div
20 ms	1 ms	2	±0.2 div
10 ms	1 ms	1	±0.2 div
5 ms	.5 ms	1	±0.2 div
2 ms	.1 ms	2	±0.2 div
1 ms	.1 ms	1	±0.2 div
.5 ms	50 µs	1	±0.2 div
.2 ms	10 µs	2	±0.2 div
.1 ms	10 µs	1	±0.2 div
50 µs	5 µs	1	±0.2 div
20 µs	1 µs	2	±0.2 div
10 µs	1 µs	1	±0.2 div
5 µs	.5 µs	1	±0.2 div
2 µs	.1 µs	2	±0.2 div
1 µs	.1 µs	1	±0.2 div
.5 µs	50 ns	1	±0.2 div
.2 µs	20 ns	1	±0.2 div
.1 µs	10 ns	1	±0.2 div
.05 µs	5 ns[1]	1	±0.2 div

d. Reset the Test Time-Base B Display Mode to B Starts After Delay.

e. CHECK—While rotating the Test Time-Base Delay Time Multiplier dial, check that the intensified portion may be positioned to any part of the sweep.

f. Reset the Test Time-Base B Delay Mode to B Triggerable After Delay.

g. CHECK—Turn the DELAY TIME MULTIPLIER dial and check that the intensified portion always starts at one of the 1 ms markers.

19. Check Amplifier Variable Range

a. Change the Type 7504 horizontal MODE to B. Set the Type 7B51 B DELAY MODE to INDEPENDENT. Set the Type 7B50 TRIGGERING SOURCE to EXT and the DISPLAY MODE to AMPLIFIER. Turn the amplifier VARIABLE fully clockwise.

[1] Type 184 H.F. Selector Output

b. Connect the low frequency sine-wave genenerator to the Type 7B50 EXT VOLTS IN. Set the sine-wave generator for 1 kHz and adjust the amplitude for a ten division horizontal trace.

c. CHECK—Turn the amplifier VARIABLE fully counterclockwise and check for one division or less of horizontal trace.

d. Disconnect the sine-wave generator.

20. Check/Adjust External Horizontal Center (R345)

a. Remove the Type 7B51 from the A horizontal compartment and place it in the right vertical compartment.

b. Change the Type 7504 VERTICAL MODE to RIGHT. Position the trace to the center vertical line with the 7B50 POSITION control.

c. CHECK—For no horizontal movement of trace as the amplifier VARIABLE is rotated from stop to stop.

d. ADJUST—R345 for no horizontal movement of trace as amplifier VARIABLE is rotated.

e. Turn the amplifier VARIABLE fully clockwise.

21. Check Amplifier Deflection Factor

a. Set the Type 7B51 TIME/DIV to .2 ms.

b. Set the Type 7504 Calibrator to 1 kHz and .4 V.

c. Connect the calibrator output through a "T" connector to the Type 7B50 and Type 7B51 EXT TRIG IN connectors.

d. CHECK—The horizontal deflection is between 4 divisions and 5 divisions.

e. Change the Type 7B50 TRIGGERING SOURCE to EXT ÷ 10 and the calibrator to 4 V.

f. CHECK—The horizontal deflection is between 3.9 divisions and 5.1 divisions.

22. Check Amplifier Bandwidth

a. Set the Type 7B50 SOURCE to EXT, COUPLING to DC, Amplifier VARIABLE fully clockwise and apply a 100 kHz sine wave from the low-frequency generator to the EXT VOLTS IN. Adjust the amplitude of the sine-wave generator for six divisions (horizontal) of display.

b. CHECK—Change the Type 7B50 COUPLING to AC, the sine-wave generator to 16 Hz and check for a minimum of 4.2 divisions of display.

c. Check the remaining positions of the COUPLING switch using Table 5-5 as a guide. Maintain a six division reference for all checks.

TABLE 5-5

COUPLING	Bandwidth Limit LOWER	UPPER	Minimum Display
AC HF REJ	16 Hz		4.2 div
AC LF REJ	70 kHz		4.2 div
AC HF REJ		100 kHz	4.2 div
AC LF REJ		500 kHz	4.2 div
DC		500 kHz	4.2 div
AC		500 kHz	4.2 div

d. Disconnect the sine-wave generator.

PARTS LIST ABBREVIATIONS

BHB	binding head brass
BHS	binding head steel
cap.	capacitor
cer	ceramic
comp	composition
conn	connector
CRT	cathode-ray tube
csk	countersunk
DE	double end
dia	diameter
div	division
elect.	electrolytic
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
ext	external
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
h	height or high
hex.	hexagonal
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
ID	inside diameter
inc	incandescent
int	internal
lg	length or long
met.	metal
mtg hdw	mounting hardware
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
P/O	part of
PHB	pan head brass
PHS	pan head steel
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
RHB	round head brass
RHS	round head steel
SE	single end
SN or S/N	serial number
S or SW	switch
TC	temperature compensated
THB	truss head brass
thk	thick
THS	truss head steel
tub.	tubular
var	variable
w	wide or width
WW	wire-wound

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

×000	Part first added at this serial number
00×	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.

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SECTION 6
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Description			
CHASSIS							
Bulb							
DS328	150-0048-00			Incandescent #683			
Capacitors							
Tolerance ±20% unless otherwise indicated.							
C142	281-0632-00			35 pF	Cer	500 V	1%
C530A	*295-0122-00			10 μF			
C530B				1 μF			
C530E				0.1 μF	Timing capacitor assembly		
C530F				0.01 μF			
C530H				995 pF			
Connector							
J141	131-0352-02	B010100	B019999	Receptacle, electrical, BNC			
J141	131-0955-00	B020000		Receptacle, electrical, BNC			
Resistors							
Resistors are fixed, composition, ±10% unless otherwise indicated.							
R141	323-0452-00			499 kΩ	½ W	Prec	1%
R142	315-0101-00			100 Ω	¼ W		5%
R260A, B[1]	*311-0912-00			2.5 kΩ x 10 kΩ, Var			
R340	311-0091-00			1 kΩ, Var			
R531	311-0959-00			10 kΩ, Var			
R740	311-0486-00			500 Ω, Var			
R744A, B	*311-0965-00	B010100	B089999	10 kΩ x 10 kΩ, Var			
R744A, B	311-1162-00	B090000		10 kΩ x 10 kΩ, Var			
Switch							
S260	*311-0972-00				SLOPE		

[1]Furnished as a unit with S260.

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INTERFACE Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
	*670-1096-00	B010100	B119999	Complete Board			
	*670-1096-01	B120000		Complete Board			
				Capacitors			
	Tolerance ±20% unless otherwise indicated.						
C143	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C530P	281-0523-00			100 pF	Cer	350 V	
C530R	281-0536-00			1000 pF	Cer	500 V	10%
C831	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
				Semiconductor Device, Diodes			
CR461	*152-0185-00			Silicon	Replaceable by 1N4152		
CR531	*152-0185-00			Silicon	Replaceable by 1N4152		
CR702	*152-0185-00	XB120000		Silicon	Replaceable by 1N4152		
				Resistors			
	Resistors are fixed, composition, ±10% unless otherwise indicated.						
R143	315-0472-00			4.7 kΩ	1/4 W		5%
R144	315-0101-00			100 Ω	1/4 W		5%
R328	315-0200-00			20 Ω	1/4 W		5%
R381	321-0193-00			1 kΩ	1/8 W	Prec	1%
R382	321-0193-00			1 kΩ	1/8 W	Prec	1%
R383	315-0432-00			4.3 kΩ	1/4 W		5%
R460	315-0472-00			4.7 kΩ	1/4 W		5%
R461	315-0752-00			7.5 kΩ	1/4 W		5%
R530A	323-0568-08			8.06 MΩ	1/2 W	Prec	1%
R530B	323-0557-08			6.19 MΩ	1/2 W	Prec	1%
R530C	323-0546-08			4.75 MΩ	1/2 W	Prec	1%
R530D	323-0546-08			4.75 MΩ	1/2 W	Prec	1%
R530F	323-0767-07			1.425 MΩ	1/2 W	Prec	1/10%
R530H	323-0450-07			475 kΩ	1/2 W	Prec	1/10%
R530J	323-0450-07			475 kΩ	1/2 W	Prec	1/10%
R530K	323-0774-07			118.7 kΩ	1/2 W	Prec	1/10%
R530L	323-0774-07			118.7 kΩ	1/2 W	Prec	1/10%
R530M	321-0267-00			5.9 kΩ	1/8 W	Prec	1%
R530P	315-0330-00			33 Ω	1/4 W		5%
R530R	315-0220-00			22 Ω	1/4 W		5%
R531	311-0959-00			10 kΩ, Var			
R701	315-0154-00			150 kΩ	1/4 W		5%
R702	315-0133-00			13 kΩ	1/4 W		5%
R704	315-0154-00			150 kΩ	1/4 W		5%
R705	321-0344-00			37.4 kΩ	1/8 W	Prec	1%
R706	315-0753-00			75 kΩ	1/4 W		5%

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INTERFACE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Resistors (cont)			
R711	315-0753-00			75 kΩ	1/4 W		5%
R712	315-0154-00			150 kΩ	1/4 W		5%
R713	315-0753-00			75 kΩ	1/4 W		5%
R721	315-0753-00			75 kΩ	1/4 W		5%
R722	315-0154-00			150 kΩ	1/4 W		5%
R723	315-0154-00			150 kΩ	1/4 W		5%
R724	321-0356-00			49.9 kΩ	1/8 W	Prec	1%
R726	315-0123-00			12 kΩ	1/4 W		5%
R727	321-0335-00			30.1 kΩ	1/8 W	Prec	1%
R728	321-0344-00			37.4 kΩ	1/8 W	Prec	1%
R729	315-0154-00			150 kΩ	1/4 W		5%
R741	315-0470-00			47 Ω	1/4 W		5%
				Switches			
	Wired or Unwired						
S530[3]	*670-1096-00	B010100	B119999	Cam		TIME/DIV	
S530[3]	*670-1096-01	B120000		Cam		TIME/DIV	
S531[3]	*670-1096-00	B010100	B119999	Push-push		CAL IN	
S531[3]	*670-1096-01	B120000		Push-push		CAL IN	

TIME BASE Circuit Board Assembly

*670-1097-00	B010100	B019999	Complete Board
*670-1097-01	B020000	B049999	Complete Board
*670-1097-02	B050000	B109999	Complete Board
*670-1097-03	B110000	B129999	Complete Board
*670-1097-04	B130000		Complete Board

Capacitors

Tolerance ±20% unless otherwise indicated.

C406	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C409	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C421	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C431	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C434	281-0577-00			14 pF	Cer	500 V	5%
C441	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C446	290-0136-00			2.2 μF	Elect.	20 V	
C456	290-0135-00	B010100	B059999	15 μF	Elect.	20 V	
C456	290-0136-00	B060000		2.2 μF	Elect.	20 V	
C457	281-0524-00			150 pF	Cer	500 V	
C466	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C469	283-0000-00			0.001 μF	Cer	500 V	
C524	281-0525-00			470 pF	Cer	500 V	
C527	281-0523-00			100 pF	Cer	350 V	
C530J	281-0093-00			5.5-18 pF, Var	Cer		
C530K	283-0126-00			82 pF	Cer	1000 V	5%

[3]See Mechanical Parts List for replacement parts.

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TIME BASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
				Capacitors (cont)		
C530L	281-0091-00			2-8 pF, Var	Cer	
C530M	281-0657-00			13 pF	Cer	500 V 2%
C532	283-0080-00			0.022 μF	Cer	25 V +80%—20%
C534	281-0626-00	B010100	B109999	3.3 pF	Cer	500 V 5%
C534	281-0544-00	B110000		5.6 pF	Cer	500 V 10%
C536	290-0136-00			2.2 μF	Elect.	20 V
C538	281-0549-00			68 pF	Cer	500 V 10%
C545	290-0136-00			2.2 μF	Elect.	20 V
C551	281-0523-00			100 pF	Cer	350 V
C556	281-0552-00			25 pF	Cer	500 V
C561	290-0136-00			2.2 μF	Elect.	20 V
C580A	283-0164-00			2.2 μF	Cer	25 V
C580B	283-0191-00			0.022 μF	Cer	50 V
C580D	283-0666-00			890 pF	Mica	100 V 2%
C582	281-0504-00			10 pF	Cer	500 V 10%
C583	283-0080-00			0.022 μF	Cer	25 V +80%—20%
C594	283-0077-00			330 pF	Cer	500 V 5%
C746	283-0080-00	B010100	B049999X	0.022 μF	Cer	25 V +80%—20%
C749	283-0080-00			0.022 μF	Cer	25 V +80%—20%
C752	283-0080-00	XB050000		0.022 μF	Cer	25 V +80%—20%
C759	281-0523-00			100 pF	Cer	350 V
C763	281-0557-00			1.8 pF	Cer	500 V ±0.1 pF
C788	290-0284-00	B010100	B019999	4.7 μF	Elect.	35 V 10%
C788	283-0164-00	B020000		2.2 μF	Cer	25 V
C789	283-0110-00	B010100	B019999	0.005 μF	Cer	150 V
C789	283-0092-00	B020000	B139999	0.03 μF	Cer	200 V +80%—20%
C789	283-0092-00	B140000		0.03 μF (nominal value), selected		
C799	290-0136-00			2.2 μF	Elect.	20 V
C801	290-0177-00	B010100	B029999	1 μF	Elect.	50 V
C801	290-0420-00	B030000		0.68 μF	Elect.	75 V
C803	290-0136-00			2.2 μF	Elect.	20 V
C805	290-0136-00			2.2 μF	Elect.	20 V
C807	290-0136-00			2.2 μF	Elect.	20 V
C809	283-0080-00			0.022 μF	Cer	25 V +80%—20%
C813	290-0136-00			2.2 μF	Elect.	20 V
C815	290-0136-00			2.2 μF	Elect.	20 V
C817	290-0136-00			2.2 μF	Elect.	20 V
C819	290-0136-00			2.2 μF	Elect.	20 V
C821	290-0177-00	B010100	B029999	1 μF	Elect.	50 V
C821	290-0420-00	B030000		0.68 μF	Elect.	75 V
				Semiconductor Device, Diodes		
CR406	*152-0185-00			Silicon	Replaceable by 1N4152	
CR412	*152-0185-00			Silicon	Replaceable by 1N4152	
CR413	*152-0185-00			Silicon	Replaceable by 1N4152	
CR414	*152-0185-00			Silicon	Replaceable by 1N4152	
CR419	*152-0185-00			Silicon	Replaceable by 1N4152	
CR427	*152-0185-00			Silicon	Replaceable by 1N4152	
CR428	*152-0185-00			Silicon	Replaceable by 1N4152	
CR431	*152-0185-00			Silicon	Replaceable by 1N4152	
CR436	*152-0185-00			Silicon	Replaceable by 1N4152	
CR446	*152-0185-00			Silicon	Replaceable by 1N4152	

TIME BASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
		Semiconductor Device, Diodes (cont)		
CR448	*152-0185-00		Silicon	Replaceable by 1N4152
CR449	*152-0185-00		Silicon	Replaceable by 1N4152
CR451	*152-0185-00		Silicon	Replaceable by 1N4152
CR452	*152-0185-00		Silicon	Replaceable by 1N4152
CR453	*152-0185-00		Silicon	Replaceable by 1N4152
CR454	*152-0185-00		Silicon	Replaceable by 1N4152
CR459	*152-0185-00		Silicon	Replaceable by 1N4152
CR462	*152-0185-00		Silicon	Replaceable by 1N4152
CR463	*152-0185-00		Silicon	Replaceable by 1N4152
CR464	*152-0185-00		Silicon	Replaceable by 1N4152
CR465	*152-0185-00		Silicon	Replaceable by 1N4152
CR466	*152-0185-00		Silicon	Replaceable by 1N4152
CR467	*152-0185-00		Silicon	Replaceable by 1N4152
CR468	*152-0185-00		Silicon	Replaceable by 1N4152
CR469	*152-0185-00		Silicon	Replaceable by 1N4152
CR525	*152-0185-00		Silicon	Replaceable by 1N4152
CR529	152-0246-00		Silicon	Low leakage 250 mW, 40 V
CR534	*152-0185-00		Silicon	Replaceable by 1N4152
CR548	152-0141-02		Silicon	1N4152
CR571	*152-0185-00		Silicon	Replaceable by 1N4152
CR572	*152-0185-00		Silicon	Replaceable by 1N4152
VR573	152-0279-00		Zener	1N751A 400 mW, 5.1 V, 5%
CR574	*152-0185-00		Silicon	Replaceable by 1N4152
VR576	152-0326-00		Zener	1N755A 400 mW, 7.5 V, 5%
CR578	*152-0185-00		Silicon	Replaceable by 1N4152
CR579	*152-0185-00		Silicon	Replaceable by 1N4152
CR580	*152-0185-00		Silicon	Replaceable by 1N4152
CR581	*152-0185-00		Silicon	Replaceable by 1N4152
CR582	*152-0185-00		Silicon	Replaceable by 1N4152
CR592	*152-0185-00		Silicon	Replaceable by 1N4152
CR594	*152-0185-00		Silicon	Replaceable by 1N4152
CR597	*152-0185-00		Silicon	Replaceable by 1N4152
CR598	*152-0185-00		Silicon	Replaceable by 1N4152
		Relay		
K780	*148-0034-00			Armature, dpdt
		Inductors		
L536	276-0507-00			Core, ferramic suppressor
L593	*108-0440-00			8 μH
L594	108-0474-00	XB130000		2 μH

TIME BASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
		Transistors		
Q406	151-0188-00			Silicon 2N3906
Q408	151-0188-00			Silicon 2N3906
Q410	151-0188-00			Silicon 2N3906
Q416	*151-0190-01			Silicon Tek Spec
Q424	*151-0190-01			Silicon Tek Spec
Q432	151-0188-00			Silicon 2N3906
Q436	151-0188-00			Silicon 2N3906
Q442	151-0188-00			Silicon 2N3906
Q446	151-0207-00			Silicon 2N3415
Q454	*151-0190-01			Silicon Tek Spec
Q456	*151-0190-01			Silicon Tek Spec
Q468	*151-0190-01			Silicon Tek Spec
Q524	151-0188-00			Silicon 2N3906
Q526	*151-0289-00			Silicon Tek Spec
Q532	*151-1036-00			FET Dual, Tek Spec
Q534	151-0188-00	B010100	B109999	Silicon 2N3906
Q534	*151-0289-00	B110000		Silicon Tek Spec
Q546	151-0220-00			Silicon 2N4122
Q554	*151-0190-01			Silicon Tek Spec
Q564	*151-0190-01			Silicon Tek Spec
Q566	*151-0190-01			Silicon Tek Spec
Q582	151-0188-00			Silicon 2N3906
Q592	*151-0190-01			Silicon Tek Spec
Q594	*151-0190-01			Silicon Tek Spec
Q752	*151-0289-00	XB050000		Silicon Tek Spec
Q754	*151-0190-01			Silicon Tek Spec
Q756	151-0220-00			Silicon 2N4122
Q764	*151-0190-01			Silicon Tek Spec
Q774	*151-0190-01			Silicon Tek Spec
Q784	151-0220-00			Silicon 2N4122
Q794	151-0220-00			Silicon 2N4122
		Resistors		
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R404	321-0247-00			3.65 kΩ 1/8 W Prec 1%
R405	321-0282-00			8.45 kΩ 1/8 W Prec 1%
R406	315-0220-00			22 Ω 1/4 W 5%
R408	322-0309-00			16.2 kΩ 1/4 W Prec 1%
R409	315-0182-00			1.8 kΩ 1/4 W 5%
R411	321-0277-00			7.5 kΩ 1/8 W Prec 1%
R412	315-0153-00			15 kΩ 1/4 W 5%
R413	315-0101-00			100 Ω 1/4 W 5%
R416	321-0315-00			18.7 kΩ 1/8 W Prec 1%
R418	315-0202-00			2 kΩ 1/4 W 5%

TIME BASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Resistors (cont)			
R419	315-0221-00		220 Ω	1/4 W		5%
R421	315-0431-00		430 Ω	1/4 W		5%
R422	315-0112-00		1.1 kΩ	1/4 W		5%
R423	315-0220-00		22 Ω	1/4 W		5%
R424	315-0302-00		3 kΩ	1/4 W		5%
R426	315-0132-00		1.3 kΩ	1/4 W		5%
R427	315-0561-00		560 Ω	1/4 W		5%
R428	321-0300-00		13 kΩ	1/8 W	Prec	1%
R431	315-0470-00		47 Ω	1/4 W		5%
R432	321-0136-00		255 Ω	1/8 W	Prec	1%
R433	321-0129-00		215 Ω	1/8 W	Prec	1%
R434	321-0265-00		5.62 kΩ	1/8 W	Prec	1%
R435	321-0244-00		3.4 kΩ	1/8 W	Prec	1%
R436	321-0167-00		536 Ω	1/8 W	Prec	1%
R437	315-0111-00		110 Ω	1/4 W		5%
R438	301-0621-00		620 Ω	1/2 W		5%
R439	315-0201-00		200 Ω	1/4 W		5%
R441	301-0470-00		47 Ω	1/2 W		5%
R444	315-0102-00		1 kΩ	1/4 W		5%
R448	321-0277-00		7.5 kΩ	1/8 W	Prec	1%
R449	315-0472-00		4.7 kΩ	1/4 W		5%
R451	315-0223-00		22 kΩ	1/4 W		5%
R452	321-0306-00		15 kΩ	1/8 W	Prec	1%
R454	315-0472-00		4.7 kΩ	1/4 W		5%
R455	315-0682-00		6.8 kΩ	1/4 W		5%
R456	315-0153-00		15 kΩ	1/4 W		5%
R458	315-0103-00		10 kΩ	1/4 W		5%
R459	315-0123-00		12 kΩ	1/4 W		5%
R462	321-0277-00		7.5 kΩ	1/8 W	Prec	1%
R464	321-0271-00		6.49 kΩ	1/8 W	Prec	1%
R465	321-0234-00		2.67 kΩ	1/8 W	Prec	1%
R466	321-0277-00		7.5 kΩ	1/8 W	Prec	1%
R468	321-0306-00		15 kΩ	1/8 W	Prec	1%
R469	321-0209-00		1.47 kΩ	1/8 W	Prec	1%
R521	315-0101-00		100 Ω	1/4 W		5%
R523	321-0260-00		4.99 kΩ	1/8 W	Prec	1%
R524	315-0621-00		620 Ω	1/4 W		5%
R525	321-0289-00		10 kΩ	1/8 W	Prec	1%
R526	321-0269-00		6.19 kΩ	1/8 W	Prec	1%
R527	321-0193-00		1 kΩ	1/8 W	Prec	1%

TIME BASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
				Resistors (cont)		
R532	315-0122-00			1.2 kΩ	1/4 W	5%
R533	321-0219-00			1.87 kΩ	1/8 W Prec	1%
R534	322-0281-00			8.25 kΩ	1/4 W Prec	1%
R536	315-0220-00			22 Ω	1/4 W	5%
R537	303-0306-00			3.26 kΩ	3 W WW	2%
R538	315-0101-00			100 Ω	1/4 W	5%
R539	315-0101-00			100 Ω	1/4 W	5%
R542	321-0260-00			4.99 kΩ	1/8 W Prec	1%
R543	315-0114-00			110 kΩ	1/4 W	5%
R544	321-0231-00			2.49 kΩ	1/8 W Prec	1%
R545	315-0470-00			47 Ω	1/4 W	5%
R546	301-0102-00			1 kΩ	1/2 W	5%
R548	301-0561-00			560 Ω	1/2 W	5%
R551	321-0211-00			1.54 kΩ	1/8 W Prec	1%
R552	321-0231-00			2.49 kΩ	1/8 W Prec	1%
R554	321-0178-00			698 Ω	1/8 W Prec	1%
R556	321-0260-00			4.99 kΩ	1/8 W Prec	1%
R557	321-0239-00			3.01 kΩ	1/8 W Prec	1%
R558	321-0193-00			1 kΩ	1/8 W Prec	1%
R561	315-0820-00			82 Ω	1/4 W	5%
R564	321-0207-00			1.4 kΩ	1/8 W Prec	1%
R565	321-0189-00			909 Ω	1/8 W Prec	1%
R566	315-0101-00			100 Ω	1/4 W	5%
R567	301-0162-00			1.6 kΩ	1/2 W	5%
R568	315-0470-00			47 Ω	1/4 W	5%
R573	321-0295-00			11.5 kΩ	1/8 W Prec	1%
R530C	323-0222-00			2 kΩ	1/2 W Prec	1%
R531	315-0223-00			22 kΩ	1/4 W	5%
R582	323-0289-00			10 kΩ	1/2 W Prec	1%
R583	315-0104-00			100 kΩ	1/4 W	5%
R592	315-0101-00			100 Ω	1/4 W	5%
R594	322-0273-00			6.81 kΩ	1/4 W Prec	1%
R596	315-0101-00			100 Ω	1/4 W	5%
R598	322-0310-00			16.5 kΩ	1/4 W Prec	1%
R599	322-0297-00			12.1 kΩ	1/4 W Prec	1%
R715	315-0154-00			150 kΩ	1/4 W	5%
R742	321-0263-00			5.36 kΩ	1/8 W Prec	1%
R743	321-0228-09			2.32 kΩ	1/8 W Prec	1%
R745	315-0220-00			22 Ω	1/4 W	5%
R746	321-0262-01			5.23 kΩ	1/8 W Prec	1/2%

TIME BASE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Resistors (cont)			
R748	315-0220-00			22 Ω	1/4 W		5%
R749	321-0373-00			75 kΩ	1/8 W	Prec	1%
R750	317-0563-00	XB050000	B129999	56 kΩ	1/8 W		5%
R750	315-0563-00	B130000		56 kΩ	1/4 W		5%
R751	315-0103-00			10 kΩ	1/4 W		5%
R752	315-0912-00			9.1 kΩ	1/4 W		5%
R754	315-0320-00			82 Ω	1/4 W		5%
R755	303-0103-00	XB050000		10 kΩ	1 W		5%
R756	323-0260-00			4.99 kΩ	1/2 W	Prec	1%
R757	315-0101-00			100 Ω	1/4 W		5%
R759	321-0220-00			1.91 kΩ	1/8 W	Prec	1%
R761	321-0225-00			2.15 kΩ	1/8 W	Prec	1%
R763	323-0205-00			1.33 kΩ	1/2 W	Prec	1%
R764	303-0302-00			3 kΩ	1 W		5%
R771	315-0152-00			1.5 kΩ	1/4 W		5%
R772	321-0244-00			3.4 kΩ	1/8 W	Prec	1%
R773	321-0205-00			1.33 kΩ	1/8 W	Prec	1%
R774	303-0332-00			3.3 kΩ	1 W		5%
R781	323-0272-00			6.65 kΩ	1/2 W	Prec	1%
R782	321-0735-00			1.001 kΩ	1/8 W	Prec	1/10%
R783	315-0752-00			7.5 kΩ	1/4 W		5%
R784	321-0228-00			2.32 kΩ	1/8 W	Prec	1%
R785	311-0597-00	B010100	B129999	50 Ω, Var			
R785	311-1221-00	B130000		50 Ω, Var			
R786	321-0088-00			80.6 Ω	1/8 W	Prec	1%
R788	317-0472-00	B010100	B129999	4.7 kΩ	1/8 W		5%
R788	315-0472-00	B130000		4.7 kΩ	1/4 W		5%
R789	317-0622-00	B010100	B019999	6.2 kΩ	1/8 W		5%
R789	317-0103-00	B020000	B129999	10 kΩ	1/8 W		5%
R789	315-0103-00	B130000	B139999	10 kΩ	1/4 W		5%
R789	315-0103-00	B140000		10 kΩ (nominal value), selected			
R791	323-0272-00			6.65 kΩ	1/2 W	Prec	1%
R794	321-0235-00			2.74 kΩ	1/8 W	Prec	1%
R795	311-0541-00	B010100	B129999	20 kΩ, Var			
R795	311-1230-00	B130000		20 kΩ, Var			
R796	321-0289-00			10 kΩ	1/8 W	Prec	1%
R797	321-0289-00			10 kΩ	1/8 W	Prec	1%
R799	315-0101-00			100 Ω	1/4 W		5%
R801	315-0510-00			51 Ω	1/4 W		5%
R803	315-0470-00			47 Ω	1/4 W		5%
R805	315-0470-00			47 Ω	1/4 W		5%
R807	315-0101-00			100 Ω	1/4 W		5%
R809	315-0101-00			100 Ω	1/4 W		5%
R815	315-0470-00			47 Ω	1/4 W		5%
R817	315-0910-00			91 Ω	1/4 W		5%
R819	315-0100-00			10 Ω	1/4 W		5%
R821	315-0510-00			51 Ω	1/4 W		5%

TRIGGER Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
	*670-1098-00	B010100	B099999	Complete Board			
	*670-1098-01	B100000		Complete Board			
				Capacitors			
Tolerance ±20% unless otherwise indicated.							
C102	281-0547-00			2.7 pF	Cer	500 V	10%
C103	281-0523-00			100 pF	Cer	350 V	
C104	283-0000-00			0.001 μF	Cer	500 V	
C105	281-0509-00			15 pF	Cer	500 V	10%
C107	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C112	281-0547-00			2.7 pF	Cer	500 V	10%
C114	283-0000-00			0.001 μF	Cer	500 V	
C118	290-0177-00			1 μF	Elect.	50 V	
C121	281-0518-00			47 pF	Cer	500 V	
C122	281-0509-00			15 pF	Cer	500 V	10%
C126	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C128	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C132	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C136	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C203	283-0000-00			0.001 μF	Cer	500 V	
C206	283-0000-00			0.001 μF	Cer	500 V	
C214	283-0000-00			0.001 μF	Cer	500 V	
C215	281-0578-00			18 pF	Cer	500 V	5%
C217	283-0000-00			0.001 μF	Cer	500 V	
C223	281-0562-00			39 pF	Cer	500 V	
C237	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C238	283-0000-00			0.001 μF	Cer	500 V	
C243	281-0562-00			39 pF	Cer	500 V	
C248	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C258	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C263	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C267	281-0505-00			12 pF	Cer	500 V	10%
C269	283-0000-00			0.001 μF	Cer	500 V	
C273	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C282	290-0263-00	B010100	B099999	2.7 μF	Elect.	15 V	
C282	290-0284-00	B100000		4.7 μF	Elect.	35 V	10%
C286	290-0284-00			4.7 μF	Elect.	35 V	10%
C293	283-0080-00			0.022 μF	Cer	25 V	+80%−20%
C307	283-0002-00			0.01 μF	Cer	500 V	
C318	290-0136-00			2.2 μF	Elect.	20 V	
C328	290-0134-00			22 μF	Elect.	15 V	
C334	283-0000-00			0.001 μF	Cer	500 V	
C339	283-0000-00			0.001 μF	Cer	500 V	
C354	290-0284-00			4.7 μF	Elect.	35 V	10%
C358	283-0111-00			0.1 μF	Cer	50 V	
C374	290-0284-00			4.7 μF	Elect.	35 V	10%

TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Capacitors (cont)			
C378	283-0111-00		0.1 μF	Cer	50 V	
C391	283-0111-00		0.1 μF	Cer	50 V	
C393	290-0284-00		4.7 μF	Elect.	35 V	10%
C394	283-0080-00		0.022 μF	Cer	25 V	+80%—20%
C395	290-0284-00		4.7 μF	Elect.	35 V	10%
C397	283-0111-00		0.1 μF	Cer	50 V	
			Semiconductor Device, Diodes			
CR203	*152-0185-00		Silicon	Replaceable by 1N4152		
CR206	*152-0185-00		Silicon	Replaceable by 1N4152		
CR221	*152-0185-00		Silicon	Replaceable by 1N4152		
VR225	152-0226-00		Zener	1N751A 400 mW, 5.1 V, 5%		
CR231	*152-0185-00		Silicon	Replaceable by 1N4152		
CR245	*152-0185-00		Silicon	Replaceable by 1N4152		
CR246	*152-0185-00		Silicon	Replaceable by 1N4152		
CR255	*152-0185-00		Silicon	Replaceable by 1N4152		
CR256	*152-0185-00		Silicon	Replaceable by 1N4152		
CR262	152-0386-00		Tunnel	25 pF, 10 mA		
CR275	*152-0185-00		Silicon	Replaceable by 1N4152		
CR277	*152-0185-00		Silicon	Replaceable by 1N4152		
CR291	*152-0322-00		Silicon	Tek Spec		
CR299	*152-0125-00		Tunnel	4.7 mA, Tek Spec		
CR301	*152-0185-00		Silicon	Replaceable by 1N4152		
CR321	*152-0185-00		Silicon	Replaceable by 1N4152		
CR341	*152-0185-00		Silicon	Replaceable by 1N4152		
CR366	*152-0185-00		Silicon	Replaceable by 1N4152		
CR386	*152-0185-00		Silicon	Replaceable by 1N4152		
			Inductors			
L262	*108-0433-00		0.09 μH			
L267	*108-0552-00		80 nH			
L275	*120-0382-00		Toroid, 14 turns, single			
			Transistors			
Q104	151-0223-00		Silicon	2N4275		
Q114	151-0223-00		Silicon	2N4275		
Q118	151-0223-00		Silicon	2N4275		
Q124	151-0224-00		Silicon	2N3692		
Q134	151-0220-00		Silicon	2N4122		

TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
		Transistors (cont)		
Q213A, B	151-1011-01	B010100	B039999	FET Dual
Q213A, B	151-1041-00	B040000		FET Dual
Q214	151-0221-00			Silicon 2N4258
Q224	151-0223-00			Silicon 2N4275
Q234	151-0223-00			Silicon 2N4275
Q238	*151-0216-00			Silicon Replaceable by MOT MPS 6523
Q244	151-0223-00			Silicon 2N4275
Q254	151-0223-00			Silicon 2N4275
Q260	151-0220-00			Silicon 2N4122
Q266	151-0220-00			Silicon 2N4122
Q273	151-0220-00			Silicon 2N4122
Q275	151-0223-00			Silicon 2N4275
Q285	151-0224-00			Silicon 2N3692
Q293	151-0224-00			Silicon 2N3692
Q296	151-0224-00			Silicon 2N3692
Q305	151-0223-00			Silicon 2N4275
Q315	151-0223-00			Silicon 2N4275
Q319	*151-0190-01			Silicon Tek Spec
Q324	151-0220-00			Silicon 2N4122
Q326	151-0220-00			Silicon 2N4122
Q328	*151-0192-00			Silicon Replaceable by MPS 6521
Q333	151-0223-00			Silicon 2N4275
Q344	*151-0190-01			Silicon Tek Spec
Q353	*151-0190-01			Silicon Tek Spec
Q356	*151-0190-01			Silicon Tek Spec
Q364	151-0188-00			Silicon 2N3906
Q366	*151-0190-01			Silicon Tek Spec
Q373	151-0188-00			Silicon 2N3906
Q376	151-0188-00			Silicon 2N3906
Q384	*151-0190-01			Silicon Tek Spec
Q386	151-0188-00			Silicon 2N3906

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R101	321-0071-00	53.6 Ω	1/8 W	Prec	1%
R103	321-0020-00	15.8 Ω	1/8 W	Prec	1%
R104	315-0131-00	130 Ω	1/4 W		5%
R105	321-0126-00	200 Ω	1/8 W	Prec	1%
R107	315-0750-00	75 Ω	1/4 W		5%
R111	321-0071-00	53.6 Ω	1/8 W	Prec	1%
R113	321-0020-00	15.8 Ω	1/8 W	Prec	1%
R114	315-0131-00	130 Ω	1/4 W		5%
R115	321-0126-00	200 Ω	1/8 W	Prec	1%
R116	315-0121-00	120 Ω	1/4 W		5%

TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Resistors *(cont)*			
R117	321-0189-00			909 Ω	1/8 W	Prec	1%
R118	321-0193-00			1 kΩ	1/8 W	Prec	1%
R119	323-0124-00			191 Ω	1/2 W	Prec	1%
R121	315-0821-00			820 Ω	1/4 W		5%
R122	321-0250-00			3.92 kΩ	1/8 W	Prec	1%
R126	315-0101-00			100 Ω	1/4 W		5%
R128	315-0301-00			300 Ω	1/4 W		5%
R129	315-0510-00			51 Ω	1/4 W		5%
R132	321-0210-00			1.5 kΩ	1/8 W	Prec	1%
R133	321-0324-00			23.2 kΩ	1/8 W	Prec	1%
R135	311-0463-00	B010100	B129999	5 kΩ, Var			
R135	311-1227-00	B130000		5 kΩ, Var			
R136	315-0101-00			100 Ω	1/4 W		5%
R201	315-0510-00			51 Ω	1/4 W		5%
R202	321-0452-00			499 kΩ	1/8 W	Prec	1%
R203	315-0512-00			5.1 kΩ	1/4 W		5%
R205	315-0512-00			5.1 kΩ	1/4 W		5%
R206	315-0512-00			5.1 kΩ	1/4 W		5%
R213	315-0511-00			510 Ω	1/4 W		5%
R214	315-0101-00			100 Ω	1/4 W		5%
R215	315-0162-00			1.6 kΩ	1/4 W		5%
R217	315-0751-00			750 Ω	1/4 W		5%
R221	315-0162-00			1.6 kΩ	1/4 W		5%
R224	315-0101-00			100 Ω	1/4 W		5%
R234	315-0101-00			100 Ω	1/4 W		5%
R235	315-0103-00			10 kΩ	1/4 W		5%
R236	315-0241-00			240 Ω	1/4 W		5%
R237	315-0100-00			10 Ω	1/4 W		5%
R238	315-0512-00			5.1 kΩ	1/4 W		5%
R239	315-0475-00			4.7 MΩ	1/4 W		5%
R241	322-0261-00			5.11 kΩ	1/4 W	Prec	1%
R243	315-0300-00			30 Ω	1/4 W		5%
R248	315-0103-00			10 kΩ	1/4 W		5%
R251	322-0261-00			5.11 kΩ	1/4 W	Prec	1%
R258	315-0203-00			20 kΩ	1/4 W		5%
R260	315-0103-00			10 kΩ	1/4 W		5%
R261	315-0202-00			2 kΩ	1/4 W		5%
R262	315-0101-00			100 Ω	1/4 W		5%
R264	315-0100-00			10 Ω	1/4 W		5%
R267	317-0300-00	B010100	B079999	30 Ω	1/8 W		5%
R267	317-0390-00	B080000	B129999	39 Ω (nominal value) Selected			
R267	315-0390-00	B130000		39 Ω (nominal value) Selected			
R269	315-0123-00			12 kΩ	1/4 W		5%

TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
				Resistors (cont)		
R271	315-0511-00			510 Ω	1/4 W	5%
R272	315-0103-00			10 kΩ	1/4 W	5%
R273	315-0512-00			5.1 kΩ	1/4 W	5%
R274	307-0103-00			2.7 Ω	1/4 W	5%
R275	315-0201-00			200 Ω	1/4 W	5%
R276	315-0752-00			7.5 kΩ	1/4 W	5%
R277	315-0303-00			30 kΩ	1/4 W	5%
R282	315-0271-00			270 Ω	1/4 W	5%
R283	315-0103-00			10 kΩ	1/4 W	5%
R286	315-0101-00			100 Ω	1/4 W	5%
R288	315-0152-00			1.5 kΩ	1/4 W	5%
R290	315-0101-00			100 Ω	1/4 W	5%
R291	315-0512-00			5.1 kΩ	1/4 W	5%
R292	317-0201-00	B010100	B129999	200 Ω	1/8 W	5%
R292	315-0201-00	B130000		200 Ω	1/4 W	5%
R293	315-0391-00			390 Ω	1/4 W	5%
R294	315-0242-00			2.4 kΩ	1/4 W	5%
R295	315-0152-00			1.5 kΩ	1/4 W	5%
R296	315-0101-00			100 Ω	1/4 W	5%
R301	321-0239-00			3.01 kΩ	1/8 W Prec	1%
R303	321-0177-00			681 Ω	1/8 W Prec	1%
R305	321-0126-00			200 Ω	1/8 W Prec	1%
R307	307-0103-00			2.7 Ω	1/4 W	5%
R308	321-0144-00			309 Ω	1/8 W Prec	1%
R309	315-0271-00			270 Ω	1/4 W	5%
R311	321-0122-00			182 Ω	1/8 W Prec	1%
R312	321-0030-00			20 Ω	1/8 W Prec	1%
R313	323-0192-00			976 Ω	1/2 W Prec	1%
R315	321-0097-00			100 Ω	1/8 W Prec	1%
R318	315-0391-00			390 Ω	1/4 W	5%
R319	315-0302-00			3 kΩ	1/4 W	5%
R322	315-0154-00			150 kΩ	1/4 W	5%
R323	315-0223-00			22 kΩ	1/4 W	5%
R324	315-0392-00			3.9 kΩ	1/4 W	5%
R326	321-0321-00			21.5 kΩ	1/8 W Prec	1%
R327	321-0285-00			9.09 kΩ	1/8 W Prec	1%
R328	315-0101-00			100 Ω	1/4 W	5%
R333	315-0302-00			3 kΩ	1/4 W	5%
R334	315-0471-00			470 Ω	1/4 W	5%
R335	311-0622-00			100 Ω, Var		
R336	311-0622-00			100 Ω, Var		

TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Resistors (cont)			
R337	321-0091-00			86.6 Ω	1/8 W	Prec	1%
R338	315-0152-00			1.5 kΩ	1/4 W		5%
R339	315-0101-00			100 Ω	1/4 W		5%
R341	315-0102-00			1 kΩ	1/4 W		5%
R342	315-0301-00			300 Ω	1/4 W		5%
R343	315-0332-00			3.3 kΩ	1/4 W		5%
R344	315-0153-00			15 kΩ	1/4 W		5%
R345	311-0644-00			20 kΩ, Var			
R346	321-0235-00			2.74 kΩ	1/8 W	Prec	1%
R347	315-0562-00			5.6 kΩ	1/4 W		5%
R352	315-0915-00			9.1 MΩ	1/4 W		5%
R353	315-0154-00			150 kΩ	1/4 W		5%
R354	315-0101-00			100 Ω	1/4 W		5%
R356	315-0915-00			9.1 MΩ	1/4 W		5%
R358	307-0103-00			2.7 Ω	1/4 W		5%
R366	315-0104-00			100 kΩ	1/4 W		5%
R367	315-0202-00			2 kΩ	1/4 W		5%
R368	321-0258-00			4.75 kΩ	1/8 W	Prec	1%
R369	315-0100-00			10 Ω	1/4 W		5%
R372	315-0915-00			9.1 MΩ	1/4 W		5%
R373	315-0101-00			100 Ω	1/4 W		5%
R376	315-0915-00			9.1 MΩ	1/4 W		5%
R378	307-0103-00			2.7 Ω	1/4 W		5%
R384	321-0254-00			4.32 kΩ	1/8 W	Prec	1%
R385	311-0462-00	B010100	B129999	1 kΩ, Var			
R385	311-1225-00	B130000		1 kΩ, Var			
R386	315-0104-00			100 kΩ	1/4 W		5%
R387	315-0152-00			1.5 kΩ	1/4 W		5%
R389	315-0100-00			10 Ω	1/4 W		5%
R391	315-0101-00			100 Ω	1/4 W		5%
R393	307-0106-00			4.7 Ω	1/4 W		5%
R394	315-0510-00			51 Ω	1/4 W		5%
R395	307-0106-00			4.7 Ω	1/4 W		5%
R397	315-0101-00			100 Ω	1/4 W		5%
				Transformer			
T271	*120-0632-00			Toroid, 2 windings			

©

DISPLAY MODE Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
	*670-1099-00	B010100	B079999	Complete Board		
	*670-1099-01	B080000		Complete Board		
			Bulb			
DS345	*150-0057-01	B010100	B079999	Incandescent	7153AS15, selected	
DS345	*150-0048-01	B080000		Incandescent	#683, selected	
			Switch			
	Wired or Unwired					
S345[4]	*670-1099-00	B010100	B079999	Pushbutton	DISPLAY MODE	
S345[4]	*670-1099-01	B080000		Pushbutton	DISPLAY MODE	

SOURCE Circuit Board Assembly

	*670-1104-00	B010100	B079999	Complete Board		
	*670-1104-01	B080000		Complete Board		
			Bulb			
DS140	*150-0057-01	B010100	B079999	Incandescent	7153AS15, selected	
DS140	*150-0048-01	B080000		Incandescent	#683, selected	
			Capacitors			
	Tolerance ±20% unless otherwise indicated.					
C140C	281-0123-00			5-25 pF, Var	Cer	
C140E	281-0610-00			2.2 pF	Cer 200 V	±0.1 pF
			Resistors			
	Resistors are fixed, composition, ±10% unless otherwise indicated.					
R140D	321-0361-00			56.2 kΩ	1/8 W Prec	1%
R140E	321-0448-00			453 kΩ	1/8 W Prec	1%
R140F	317-0470-00			47 Ω	1/8 W	5%
R140G	317-0470-00			47 Ω	1/8 W	5%
			Switch			
	Wired or Unwired					
S140[4]	*670-1104-00	B010100	B079999	Pushbutton	SOURCE	
S140[4]	*670-1104-01	B080000		Pushbutton	SOURCE	

[4]See Mechanical Parts List for replacement parts.

MODE AUTO LEVEL Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
	*670-1105-00	B010100	B079999	Complete Board		
	*670-1105-01	B080000		Complete Board		
			Bulbs			
DS325	*150-0057-01	B010100	B079999	Incandescent	7153AS15, selected	
DS325	*150-0048-01	B080000		Incandescent	#683, selected	
DS446	*150-0057-01	B010100	B079999	Incandescent	7153AS15, selected	
DS446	*150-0048-01	B080000		Incandescent	#683, selected	
			Switch			
	Wired or Unwired					
S325[5]	*670-1105-00	B010100	B079999	Pushbutton	MODE	
S325[5]	*670-1105-01	B080000		Pushbutton	MODE	

COUPLING Circuit Board Assembly

	*670-1106-00	B010100	B079999	Complete Board		
	*670-1106-01	B080000		Complete Board		
			Bulb			
DS145	*150-0057-01	B010100	B079999	Incandescent	7153AS15, selected	
DS145	*150-0048-01	B080000		Incandescent	#683, selected	
			Capacitors			
Tolerance ±20% unless otherwise indicated.						
C145A	281-0605-00			200 pF	Cer	500 V
C145B	281-0610-00			2.2 pF	Cer	200 V ±0.1 pF
C145C	281-0505-00			12 pF	Cer	500 V 10%
C145D	281-0091-00			2-8 pF, Var	Cer	
C145E	283-0006-00			0.02 μF	Cer	500 V
			Resistors			
Resistors are fixed, composition, ±10% unless otherwise indicated.						
R145A	315-0513-00			51 kΩ	¼ W	5%
R145B	315-0333-00			33 kΩ	¼ W	5%
R145E	317-0101-00	B010100	B129999	100 Ω	⅛ W	5%
R145E	315-0101-00	B130000		100 Ω	¼ W	5%

[5]See Mechanical Parts List for replacement parts.

COUPLING Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
		Switch			
	Wired or Unwired				
S145[6]	*670-1106-00	B010100	B079999	Pushbutton	COUPLING
S145[6]	*670-1106-01	B080000		Pushbutton	COUPLING

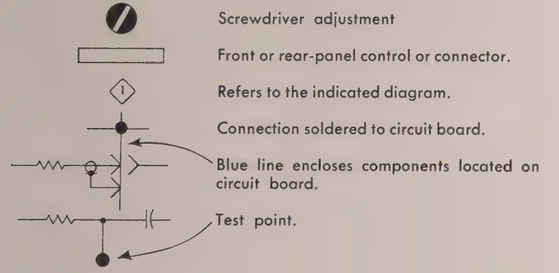
MAGNIFIER Circuit Board Assembly

*670-1107-00	B010100	B079999	Complete Board	
*670-1107-01	B080000		Complete Board	
	Bulb			
DS780	*150-0057-01	B010100	B079999	Incandescent	7153AS15, selected
DS780	*150-0048-01	B080000		Incandescent	#683, selected
	Switch			
	Wired or Unwired				
S780[6]	*670-1107-00	B010100	B079999	Pushbutton	MAGNIFIER
S780[6]	*670-1107-01	B080000		Pushbutton	MAGNIFIER

[6]See Mechanical Parts List for replacement parts.

SECTION 7
DIAGRAMS
and
MECHANICAL PARTS ILLUSTRATIONS

The following special symbols are used on the diagrams:



Screwdriver adjustment

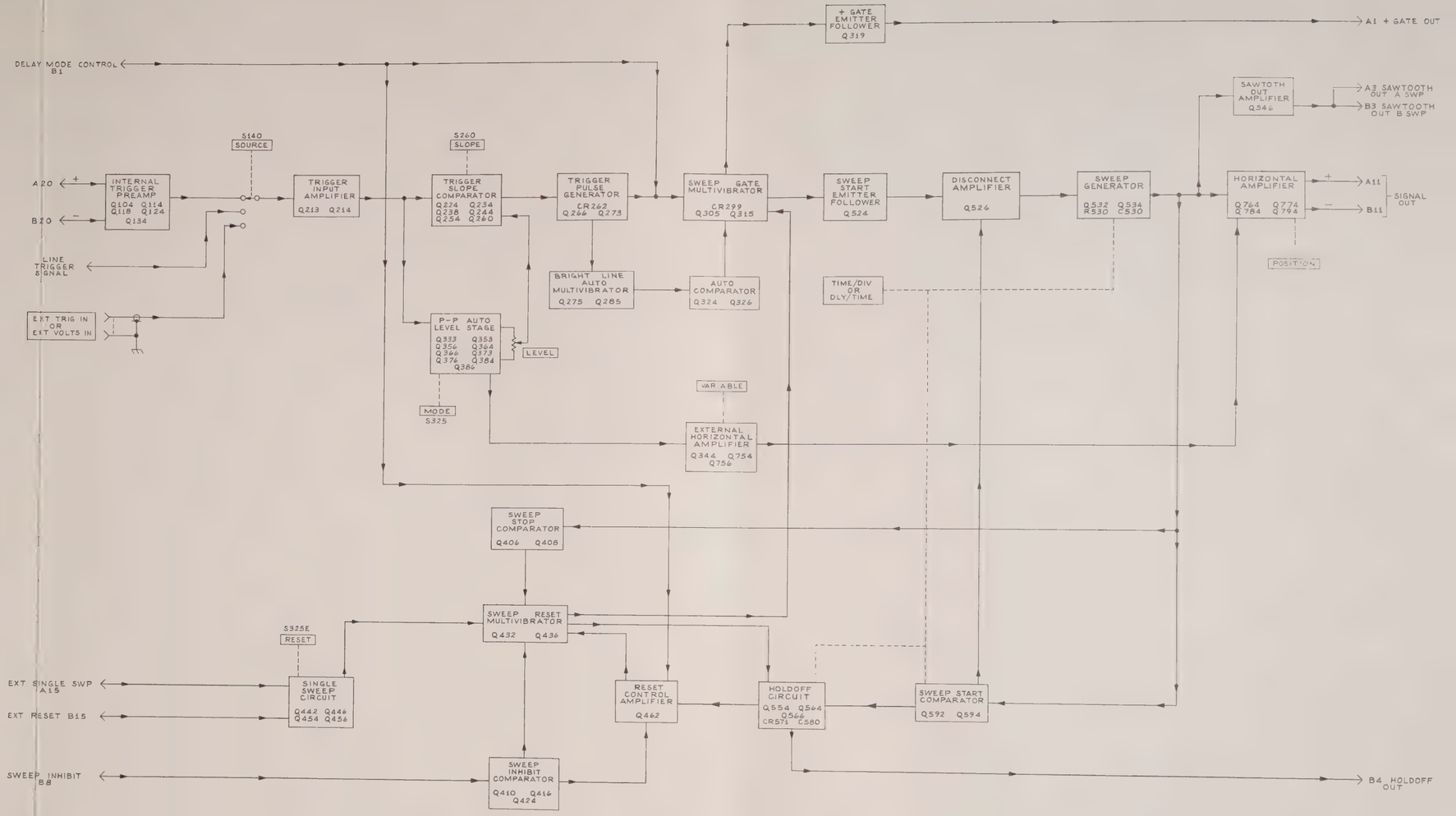
Front or rear-panel control or connector.

Refers to the indicated diagram.

Connection soldered to circuit board.

Blue line encloses components located on circuit board.

Test point.


DELAY MODE CONTROL B1
+ GATE EMITTER FOLLOWER Q319
A1 + GATE OUT
SAWTOOTH OUT AMPLIFIER Q546
A3 SAWTOOTH OUT A SWP
B3 SAWTOOTH OUT B SWP
S140 SOURCE
S260 SLOPE
A20 +
B20 −
INTERNAL TRIGGER PREAMP Q104 Q114 Q118 Q124 Q134
TRIGGER INPUT AMPLIFIER Q213 Q214
TRIGGER SLOPE COMPARATOR Q224 Q234 Q238 Q244 Q254 Q260
TRIGGER PULSE GENERATOR CR262 Q266 Q273
SWEEP GATE MULTIVIBRATOR CR299 Q305 Q315
SWEEP START EMITTER FOLLOWER Q524
DISCONNECT AMPLIFIER Q524
SWEEP GENERATOR Q532 Q534 R530 C530
HORIZONTAL AMPLIFIER Q764 Q774 Q784 Q794
A11 +
B11 −
SIGNAL OUT
POSITION
LINE TRIGGER SIGNAL
EXT TRIG IN OR EXT VOLTS IN
BRIGHT LINE AUTO MULTIVIBRATOR Q275 Q285
AUTO COMPARATOR Q324 Q326
TIME/DIV OR DLY/TIME
P-P AUTO LEVEL STAGE Q333 Q353 Q356 Q364 Q366 Q373 Q376 Q384 Q386
LEVEL
MODE S325
VARIABLE
EXTERNAL HORIZONTAL AMPLIFIER Q344 Q754 Q756
SWEEP STOP COMPARATOR Q406 Q408
SWEEP RESET MULTIVIBRATOR Q432 Q436
S325E RESET
EXT SINGLE SWP A15
EXT RESET B15
SINGLE SWEEP CIRCUIT Q442 Q446 Q454 Q456
RESET CONTROL AMPLIFIER Q462
HOLDOFF CIRCUIT Q554 Q564 Q566 CR571 C580
SWEEP START COMPARATOR Q592 Q594
SWEEP INHIBIT B8
SWEEP INHIBIT COMPARATOR Q410 Q416 Q424
B4 HOLDOFF OUT

7B50 PLUG-IN

VOLTAGE AND WAVEFORM TEST CONDITIONS

Voltage measurements and waveform photographs were obtained under the following conditions unless otherwise noted on the individual diagrams:

Type 7504 Oscilloscope

FOCUS	Optimum
INTENSITY (both)	Optimum
CALIBRATOR VOLTS	20 mV
CALIBRATOR RATE	1 kHz
VERTICAL MODE	RIGHT
HORIZONTAL MODE	A
A TRIGGER SOURCE	RIGHT VERT
B TRIGGER SOURCE	LEFT VERT

Type 7A16 (Left Vertical Compartment)

POLARITY	+ UP
BANDWIDTH	FULL
AC-GND-DC	DC
VOLTS/DIV	5 mV
INPUT	Connected through a 50 Ω termination and BNC cable to the oscilloscope calibrator output connector.

Type 7A16 (Right Vertical Compartment) With 10X Probe, Test Vertical Amplifier

POLARITY	+ UP
BANDWIDTH	FULL
AC-GND-DC	DC
VOLTS/DIV	As shown on waveform using a 10X probe.

Type 7B51 (A Horizontal Compartment) Test Time-Base

LEVEL/SLOPE	0/+
TRIGGERING	
MODE	P-P AUTO
COUPLING	AC
SOURCE	EXT
MAGNIFIER	X1
TIME/DIV	As shown on waveform
B DELAY MODE	INDEPENDENT (except as noted)
EXT TRIG IN	Connected to oscilloscope + Gate output connector

Type 7B50 (B Horizontal Compartment)

LEVEL/SLOPE	0/+
TRIGGERING	
MODE	P-P AUTO
COUPLING	DC
SOURCE	INT
MAGNIFIER	X1
TIME/DIV	0.5 ms
DISPLAY MODE	TIME BASE (except as noted)

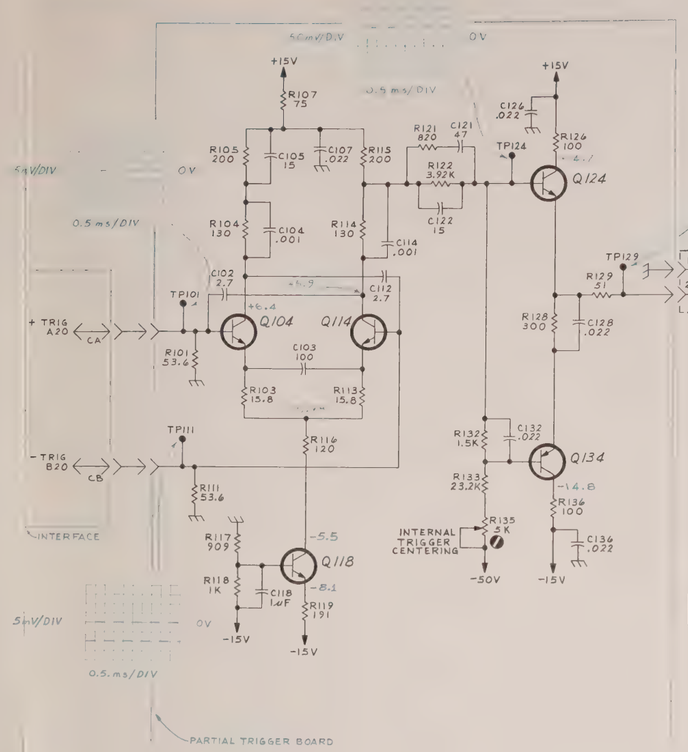
Voltmeter

Type	Non-loading DC VTVM
Sensitivity	20,000 ohms/volt
Range	0 to 50 volts
Type used for voltages on diagrams	General Radio Type 1806-A Electronic Voltmeter

All voltages given on the diagrams are in volts. Waveforms shown are actual waveform photographs taken from a Tektronix Camera System. Voltages and waveforms on the diagrams (shown in blue) are not absolute and may vary between instruments because of differing component tolerances, internal calibration or front-panel control settings.

NOTE

Vertical deflection factor shown on waveforms does not include attenuation factor of the 10X Probe.

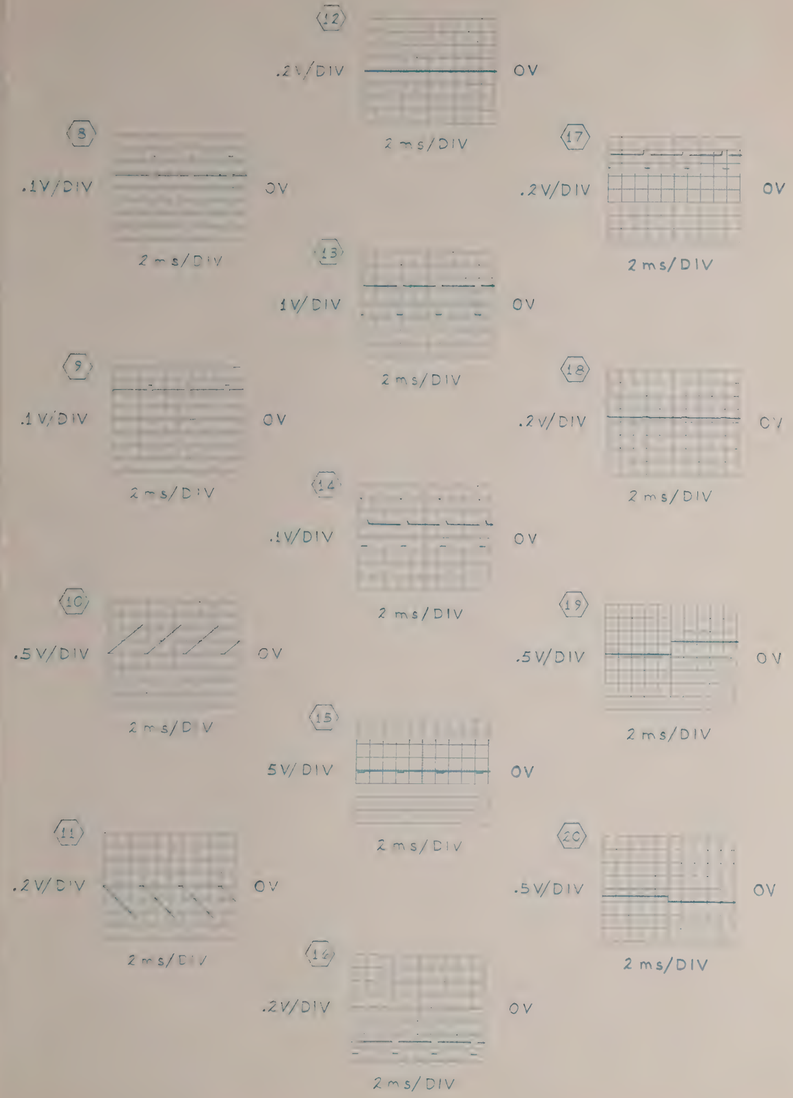


VOLTAGES and WAVEFORMS obtained under conditions on diagram <1> except as follows:

VOLTAGES ..... no signal applied

REFERENCE DIAGRAMS
- 2 TRIGGER GENERATOR
- 7 SWITCHING DIAGRAM

NOTE:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.



WAVEFORMS

SWEEP START FROM R309 AQ

SWEEP INHIBIT FROM B8 AC

REMOTE READY LIGHT FROM A10 AB

READY D1448

SWEEP RESET TO R796

S375E RESET

EXT SINGLE SWEEP RESET FROM B13

S325A SINGLE SWP (MODE)

EXT SINGLE SWEEP FROM B13

DELAY MODE CONTROL FROM B1

PARTIAL INTERFACE BOARD

7850 PLUG-IN

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE

PARTIAL INTERFACE BOARD

TIME-BASE GENERATOR BOARD

S530 TIME/DIV

SAWTOOTH TO R741

SAWTOOTH OUT

B SWEEP B3

A SWEEP A3

TO B4

TO B5

HOLD-OFF

VOLTAGES and WAVEFORMS observed under conditions

WAVEFORM at TP 416 and TP 432 only Test

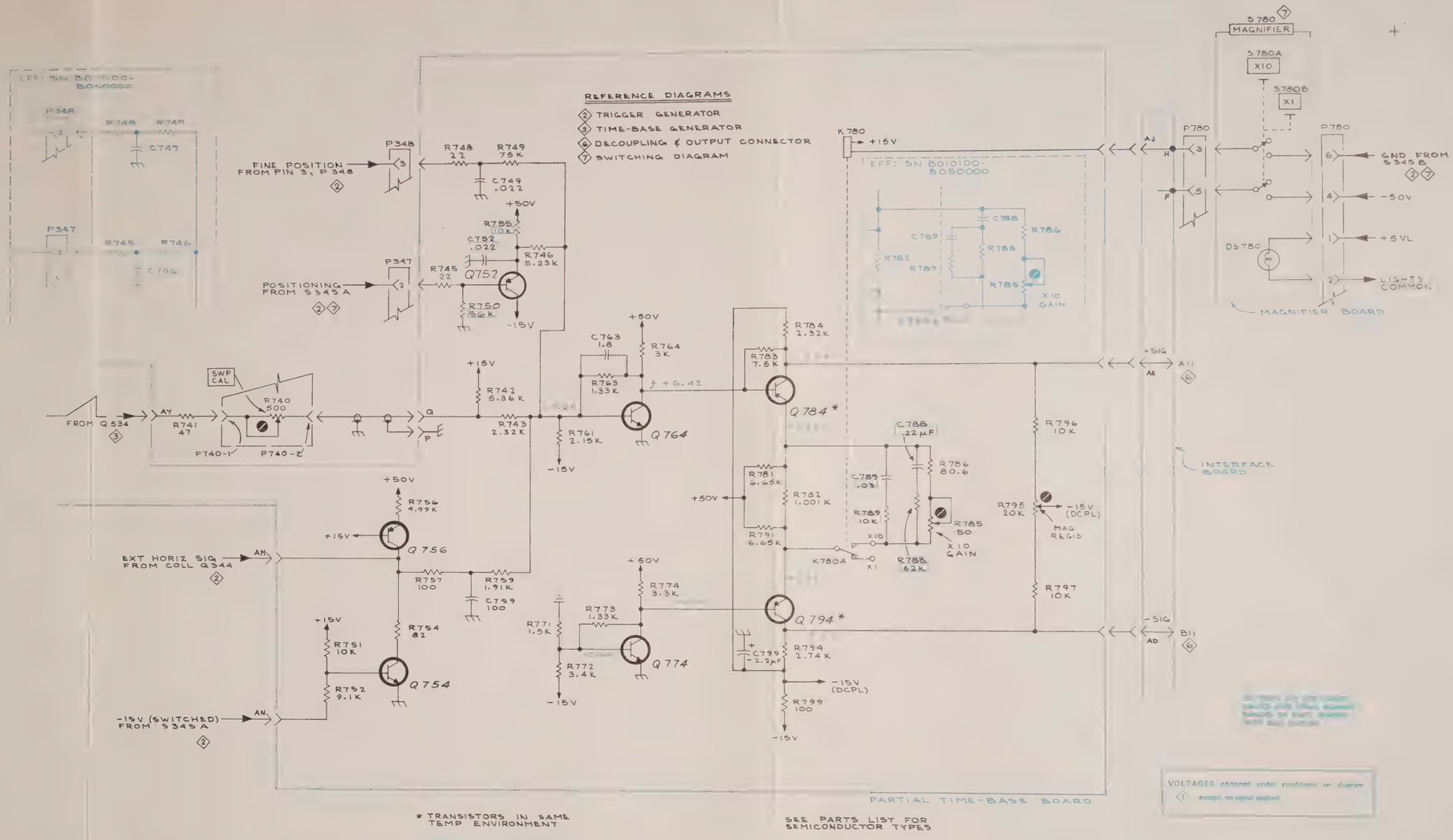
Time Base B DELAY MODE at B STARTS AFTER DELAY and Type 7850 DISPLAY MODE at A INTENSIFIED

REFERENCE DIAGRAMS

- TRIGGER GENERATOR
- TIMING SWITCH
- HORIZONTAL PREAMP
- DECOUPLING & OUTPUT CONNECTORS
- SWITCHING DIAGRAM

NOTES

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

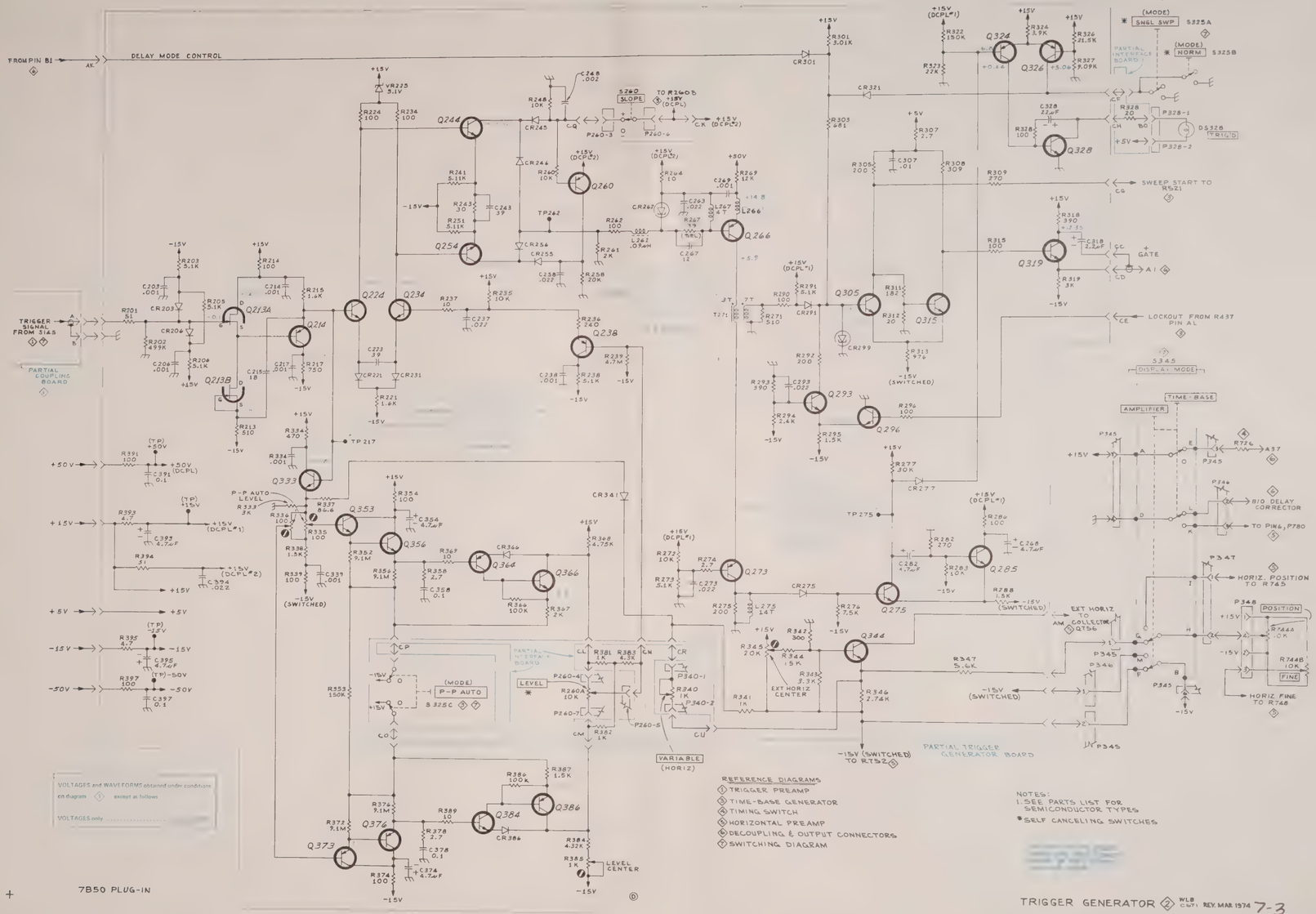


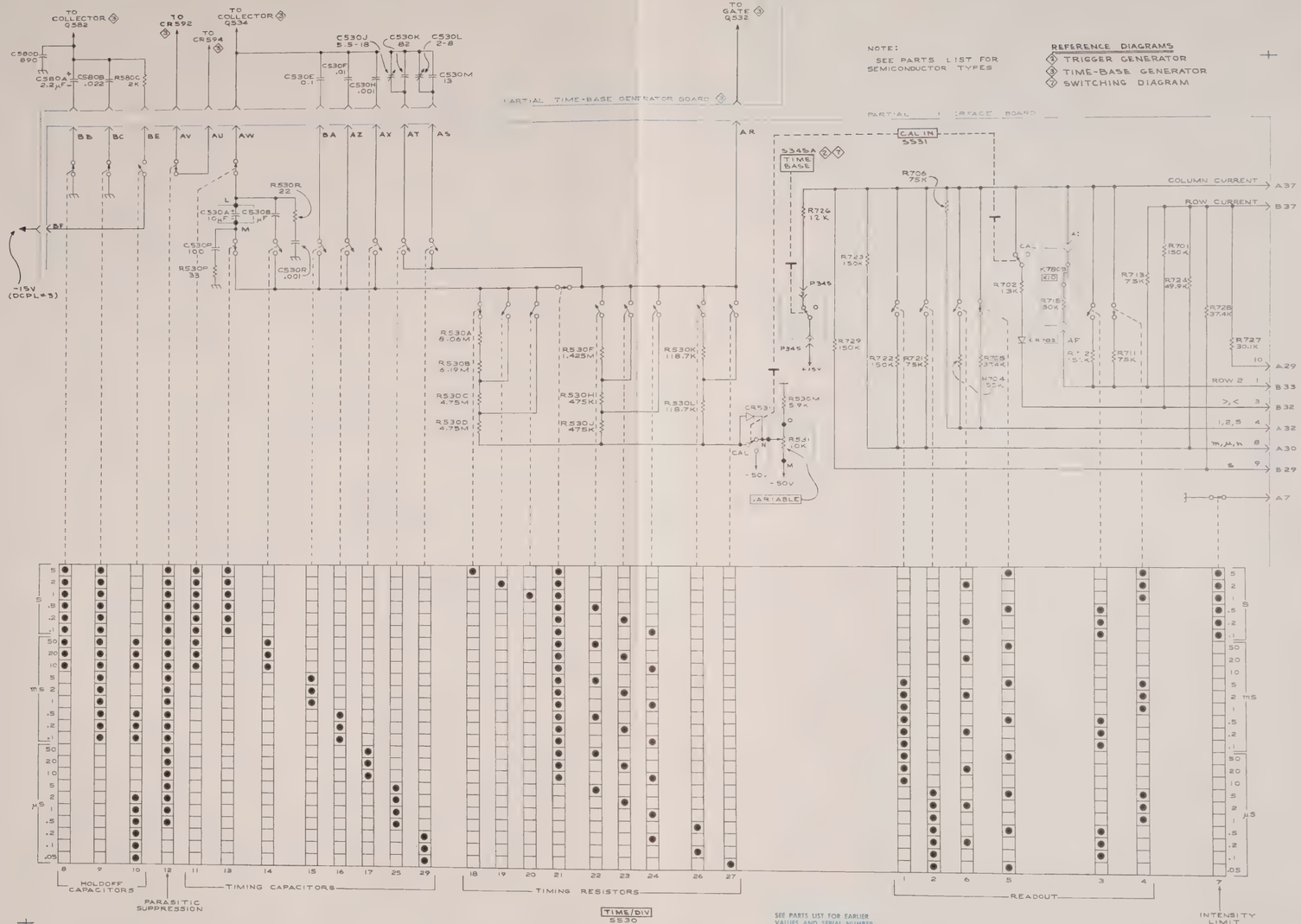
7B50 PLUG-IN

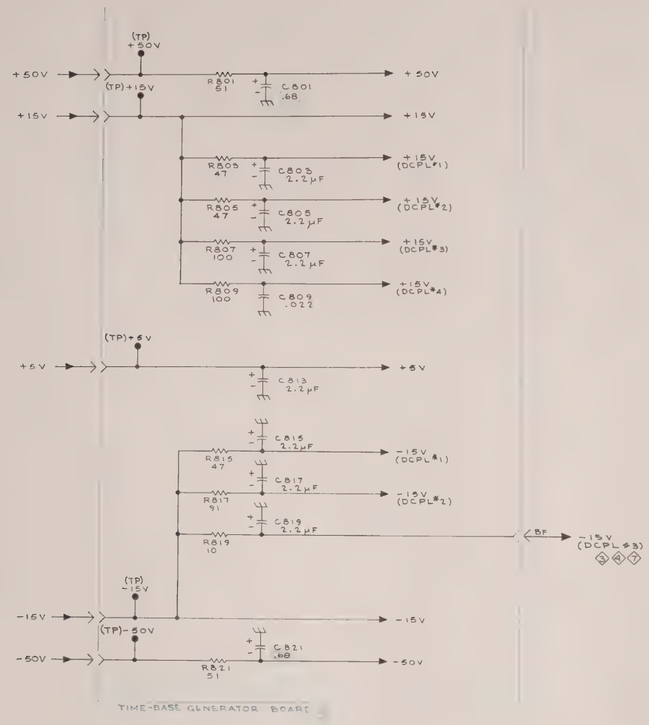
HORIZONTAL PREAMP 5 7-6

REV. MAR 1974

hq 1170


FROM PIN B1
DELAY MODE CONTROL
CR301
TRIGGER SIGNAL FROM S145
PARTIAL COUPLING BOARD
Q213A
Q213B
Q214
Q224
Q234
Q238
Q244
Q254
Q260
Q266
Q273
Q275
Q285
Q293
Q296
Q305
Q315
Q324
Q326
Q328
Q333
Q353
Q356
Q364
Q366
Q373
Q376
Q384
Q386
Q319
VR225 5.1V
S260 SLOPE
TO R1605
P260-3
P260-6
P260-4
P260-7
P260-5
P340-1
P340-2
VARIABLE (HORIZ)
(MODE) SNGL SWP S325A
(MODE) NORM S325B
PARTIAL INTERFACE BOARD 1
DS328 TRIG'D
SWEEP START TO R521
GATE
LOCKOUT FROM R437 PIN A1
S345 DISPLAY MODE
TIME-BASE AMPLIFIER
P345
P346
P347
P348
B10 DELAY CORRECTOR
TO PIN 6, P780
HORIZ. POSITION TO R745
POSITION
HORIZ FINE TO R748
FINE
EXT HORIZ TO AM COLLECTOR QT56
EXT HORIZ CENTER
LEVEL CENTER
P-P AUTO LEVEL
LEVEL
(MODE) P-P AUTO S 325C
PARTIAL TRIGGER GENERATOR BOARD
-15V (SWITCHED) TO R752
+50 V
+15 V
+5 V
-15 V
-50 V
+15V (DCPL)
+15V (DCPL#1)
+15V (DCPL#2)
-15V (SWITCHED)
+50V (DCPL)
VOLTAGES and WAVEFORMS obtained under conditions on diagram 1 except as follows
VOLTAGES only
REFERENCE DIAGRAMS
1 TRIGGER PREAMP
2 TIME-BASE GENERATOR
3 TIMING SWITCH
4 HORIZONTAL PREAMP
5 DECOUPLING & OUTPUT CONNECTORS
6 SWITCHING DIAGRAM
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES
*SELF CANCELING SWITCHES
7B50 PLUG-IN
TRIGGER GENERATOR 2 WLB C1471 REV. MAR 1974
7-3


TO COLLECTOR Q582
TO CR592
TO CR594
TO COLLECTOR Q534
TO GATE Q532
C580D 890
C580A 2.2μF
C580B .022
R580C 2K
C530J 5.5-18
C530K 62
C530L 2-8
C530E 0.1
C530F .01
C530H .001
C530M 13
PARTIAL TIME-BASE GENERATOR BOARD
PARTIAL INTERFACE BOARD
NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
REFERENCE DIAGRAMS
TRIGGER GENERATOR
TIME-BASE GENERATOR
SWITCHING DIAGRAM
BB BC BE AV AU AW BA AZ AX AT AS AR
BF
-15V (DCPL+3)
R530R 22
C530A 10pF
C530B HF
C530P 100
C530R .001
R530P 33
CAL IN 5531
5345A TIME BASE
R706 75K
R726 12K
R723 150K
R729 150K
R722 150K
R721 75K
R702 13K
R715 30K
R713 75K
R724 49.9K
R728 37.4K
R727 30.1K
R701 150K
R765 37.4K
R704 50K
R711 75K
K78C8 K10
CR703
AF
COLUMN CURRENT A37
ROW CURRENT B37
ROW 2 B33
B32
A32
A30
B29
A7
A29
R530A 8.06M
R530B 6.19M
R530C 4.75M
R530D 4.75M
R530F 1.425M
R530H 475K
R530J 475K
R530K 118.7K
R530L 118.7K
R530M 5.9K
CR531
R531 1.0K
CAL
-50V
-90V
VARIABLE
P345
+15V
HOLDOFF CAPACITORS
PARASITIC SUPPRESSION
TIMING CAPACITORS
TIMING RESISTORS
READOUT
INTENSITY LIMIT
TIME/DIV 5530
(TIME/DIV SWITCH SHOWN IN 5 SEC POSITION)
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

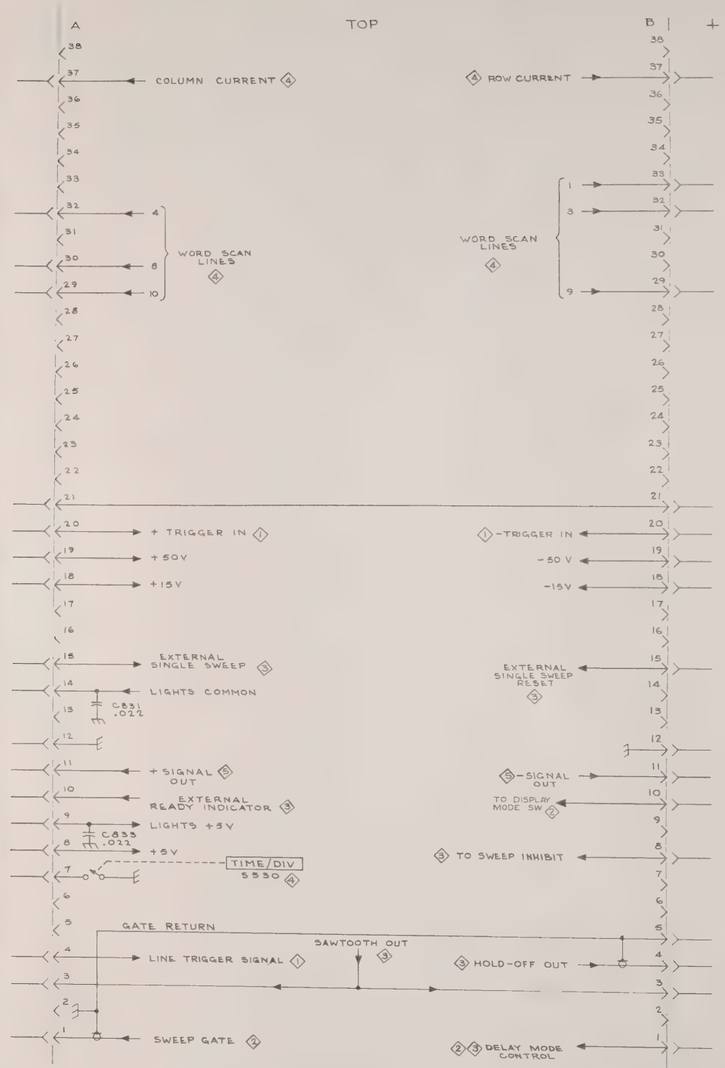


TIME-BASE GENERATOR BOARD

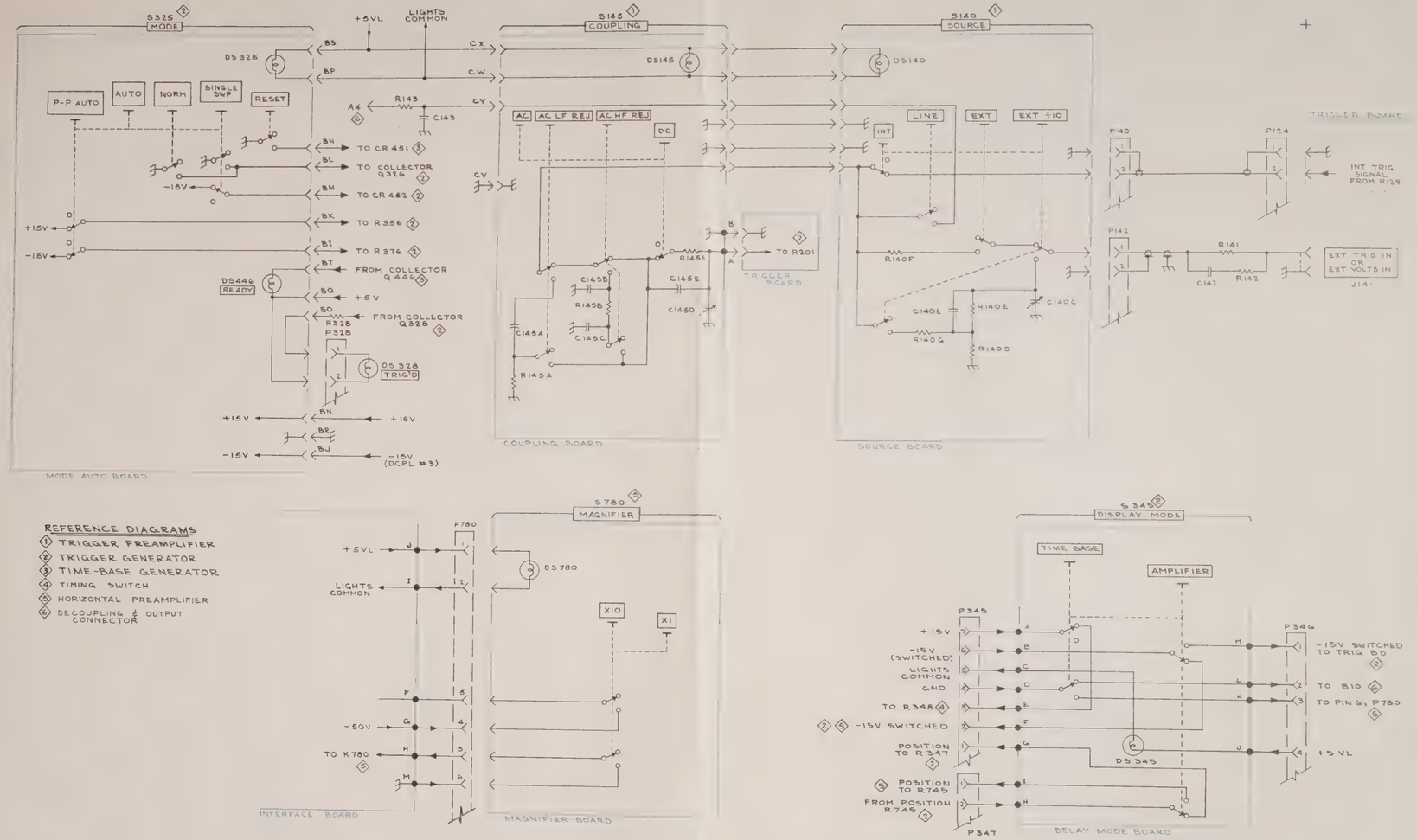
REFERENCE DIAGRAMS

1. TRIGGER PREAMPLIFIER
2. TRIGGER GENERATOR
3. TIME-BASE GENERATOR
4. TIMING SWITCH
5. HORIZONTAL PREAMPLIFIER
7. SWITCHING DIAGRAM

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

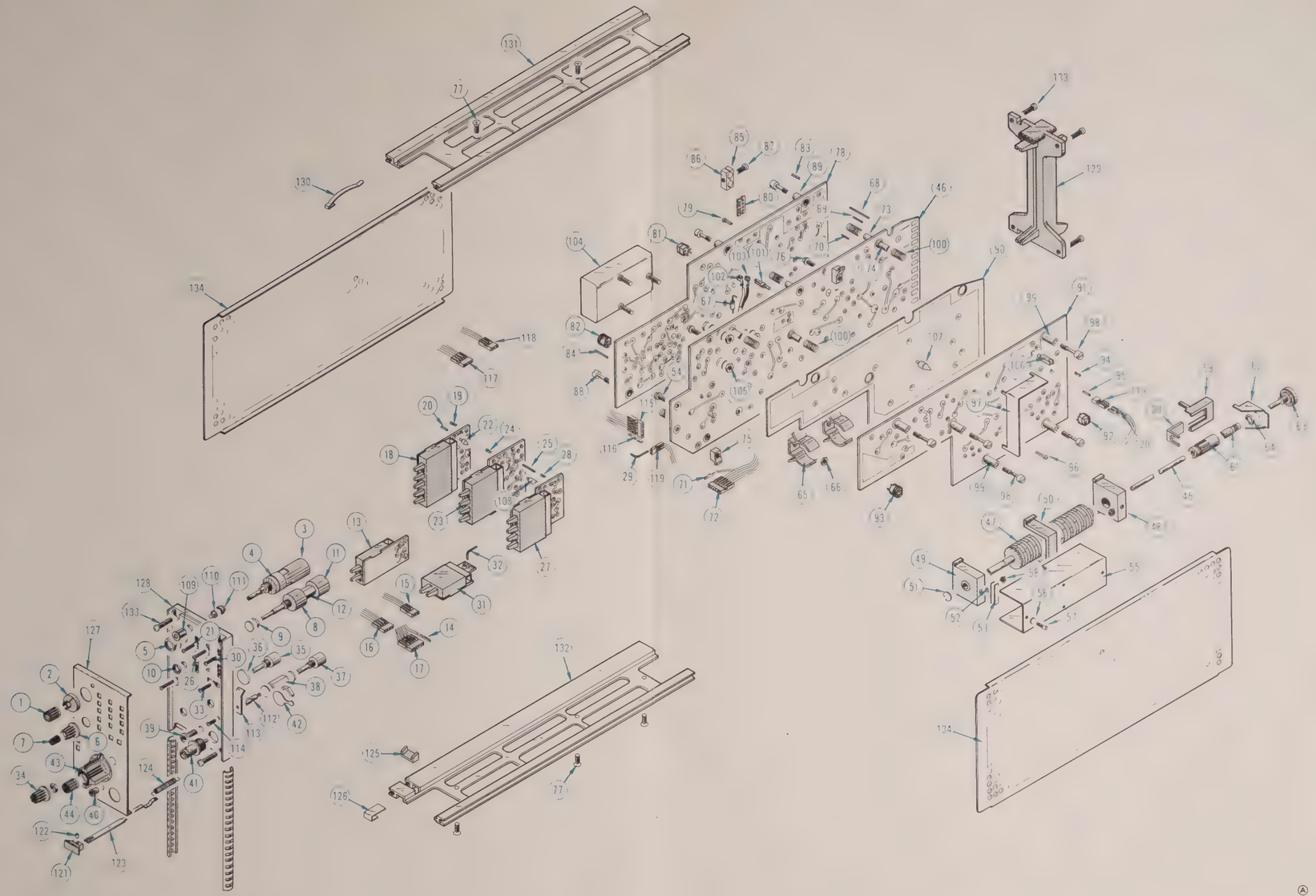


DECOUPLING & OUTPUT CONNECTOR 5 0870 7-7



REFERENCE DIAGRAMS

1. TRIGGER PREAMPLIFIER
2. TRIGGER GENERATOR
3. TIME-BASE GENERATOR
4. TIMING SWITCH
5. HORIZONTAL PREAMPLIFIER
6. DECOUPLING & OUTPUT CONNECTOR



TYPE 7B50 TIME BASE

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear either on the back of the diagrams or on pullout pages immediately following the diagrams of the instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS ILLUSTRATIONS

Title **Location** (reverse side of)

Figure 1. Exploded ..... Switching Diagram

SECTION 8
MECHANICAL PARTS LIST

FIGURE 1 EXPLODED

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
1-1	366-1064-00			1	KNOB, gray—LEVEL/SLOPE
	- - - - - -			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-2	354-0342-00			1	RING, knob skirt
-3	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	resistor includes:
-4	214-1235-00			1	DRIVE, turns reduction
	- - - - - -			-	mounting hardware: (not included w/drive)
	210-0978-00			1	WASHER, flat, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch OD
-5	210-0590-00			1	NUT, hex., $\frac{3}{8}$-32 x $\frac{5}{16}$ inch
-6	366-1174-00	B010100	B089999	1	KNOB, gray—POSITION
	366-1077-00	B090000		1	KNOB, gray—POSITION
	- - - - - -			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-7	366-1173-00	B010100	B089999	1	KNOB, gray—FINE
	366-1319-00	B090000		1	KNOB, gray—FINE
	- - - - - -			-	knob includes:
	213-0239-00			1	SETSCREW, 3-48 x 0.062 inch, HSS
-8	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-9	210-0465-00			1	NUT, hex., $\frac{1}{4}$-32 x $\frac{3}{8}$ inch
	210-0046-00			1	WASHER, lock, internal, 0.261 x 0.400 inch OD
-10	210-0583-00			1	NUT, hex., $\frac{1}{4}$-32 x $\frac{5}{16}$ inch
-11	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-12	210-0465-00			1	NUT, hex., $\frac{1}{4}$-32 x $\frac{3}{8}$ inch
-13	670-1099-00	B010100	B079999	1	ASSEMBLY, pushbutton switch—DISPLAY MODE
	670-1099-01	B080000		1	ASSEMBLY, pushbutton switch—DISPLAY MODE
	- - - - - -			-	assembly includes:
	- - - - - -			1	BULB
	380-0148-01			1	HOUSING, bulb cover
	- - - - - -			-	mounting hardware: (not included w/housing)
	213-0181-00			1	SCREW, thread forming, #2 x 0.375 inch, PHS
-14	131-0707-00			13	CONNECTOR, AWG 22 to 26 wire
-15	352-0169-00			1	HOLDER, terminal connector, 2 terminal
-16	352-0162-00			1	HOLDER, terminal connector, 4 terminal
-17	352-0165-00			1	HOLDER, terminal connector, 7 terminal
	- - - - - -			-	mounting hardware: (not included w/assembly)
	211-0156-00			1	SCREW, 1-72 x 0.250 inch, 82°, csk, FHS
-18	670-1105-00	B010100	B079999	1	ASSEMBLY, pushbutton switch—MODE (Triggering)
	670-1105-01	B080000		1	ASSEMBLY, pushbutton switch—MODE (Triggering)
	- - - - - -			-	assembly includes:
	380-0156-03			1	HOUSING, bulb cover
	- - - - - -			-	mounting hardware: (not included w/housing)
	213-0181-00			1	SCREW, thread forming, #2 x 0.375 inch, PHS

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
1-19	136-0263-03			13	SOCKET, pin terminal
-20	131-0608-00			2	TERMINAL, post 0.365 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-21	211-0156-00			2	SCREW, 1-72 x 0.250 inch, 82°, csk, FHS
-22	386-1635-00			2	SUPPORT, circuit board, for 0.118 inch board height
-23	670-1106-00	B010100	B079999	1	ASSEMBLY, pushbutton switch—COUPLING (Triggering)
	670-1106-01	B080000		1	ASSEMBLY, pushbutton switch—COUPLING (Triggering)
	- - - - - -			-	assembly includes:
	380-0155-02			1	HOUSING, bulb cover
	- - - - - -			-	mounting hardware: (not included w/housing)
	213-0181-00			1	SCREW, thread forming, #2 x 0.375 inch, PHS
-24	136-0327-00	B010100	B020579	4	SOCKET, pin terminal
	136-0327-01	B020580		4	SOCKET, pin terminal
-25	131-0590-00			6	TERMINAL, pin, 0.71 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-26	211-0156-00			2	SCREW, 1-72 x 0.250 inch, 82°, csk, FHS
-27	670-1104-00	B010100	B079999	1	ASSEMBLY, pushbutton switch—SOURCE (Triggering)
	670-1104-01	B080000		1	ASSEMBLY, pushbutton switch—SOURCE (Triggering)
	- - - - - -			-	assembly includes:
	380-0155-02			1	HOUSING, bulb cover
	- - - - - -			-	mounting hardware: (not included w/housing)
	213-0181-00			1	SCREW, thread forming, #2 x 0.375 inch, PHS
-28	136-0327-00	B010100	B020579	6	SOCKET, pin terminal
	136-0327-01	B020580		6	SOCKET, pin terminal
-29	131-0589-00			4	TERMINAL, pin, 0.50 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-30	211-0156-00			2	SCREW, 1-72 x 0.250 inch, 82°, csk, FHS
-31	670-1107-00	B010100	B079999	1	ASSEMBLY, pushbutton switch—MAGNIFIER
	670-1107-01	B080000		1	ASSEMBLY, pushbutton switch—MAGNIFIER
	- - - - - -			-	assembly includes:
	380-0148-01			1	HOUSING, bulb cover
	- - - - - -			-	mounting hardware: (not included w/housing)
	213-0181-00			1	SCREW, thread forming, #2 x 0.375 inch, PHS
-32	131-0589-00			6	TERMINAL, pin, 0.50 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-33	211-0156-00			1	SCREW, 1-72 x 0.250 inch, FHS
-34	366-1189-00			1	KNOB, gray—VARIABLE
	- - - - - -			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-35	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-36	361-0143-00	B010100	B121539	1	SPACER, locking
	210-0583-00	B010100	B121539	1	NUT, hex., 1/4-32 x 5/16 inch
	210-0583-00	B121540		2	NUT, hex., 1/4-32 x 5/16 inch

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
1-37	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0046-00			2	WASHER, lock, internal, 0.261 ID x 0.400 inch OD
-38	129-0252-00			1	POST, metallic, 0.471 inch long
-39	358-0409-00			1	BUSHING, machine thread
-40	358-0301-02			1	BUSHING, sleeve, front panel trim
-41	131-0352-02	B010100	B020419	1	CONNECTOR, coaxial, 1 contact BNC, w/hardware
	131-0955-00	B020420		1	CONNECTOR, coaxial, 1 contact BNC, w/hardware
	- - - - - -			-	mounting hardware: (not included w/connector)
-42	210-0255-00			1	LUG, solder, 3/8 ID x 1/2 inch OD, SE
-43	366-1103-00			1	KNOB, gray—TIME/DIV
	- - - - - -			-	knob includes:
	213-0020-00			2	SETSCREW, 6-32 x 1/8 inch, HSS
-44	366-1166-00			1	KNOB, red—VARIABLE (CAL IN)
	- - - - - -			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-45	384-0490-00			1	SHAFT, extension, 5.93 inches long
-46	670-1096-00	B010100	B119999	1	ASSEMBLY, circuit board—INTERFACE
	670-1096-01	B120000		1	ASSEMBLY, circuit board—INTERFACE
	- - - - - -			-	assembly includes:
	388-1330-00			1	BOARD, circuit
-47	105-0116-00			1	DRUM, cam switch—TIME/DIV
-48	401-0056-00			1	BEARING, rear
-49	401-0057-00			1	BEARING, front
-50	407-0653-00			1	BRACKET, support
-51	354-0219-00			1	RING, retainer
-52	214-1127-00			1	ROLLER, detent
-53	214-1139-00[1]			-	SPRING, flat, gold
	214-1139-02[1]			-	SPRING, flat, green
	214-1139-03[1]			-	SPRING, flat, red
	210-0591-00			6	NUT, hex., 4-40 x 3/16 inch
-54	211-0116-00			6	SCREW, sems, 4-40 x 5/16 inch, PHB
-55	200-0963-00			1	COVER, cam switch
	- - - - - -			-	mounting hardware: (not included w/cover)
-56	210-0001-00			4	WASHER, lock, internal, #2
-57	211-0079-00			4	SCREW, 2-56 x 0.188 inch, PHS
-58	210-0405-00			4	NUT, hex., 2-56 x 3/16 inch
-59	351-0180-00			1	GUIDE, actuator
-60	214-1136-00			1	SLIDE, actuator
-61	214-1190-00			1	NUT, hex., 1/4-32 x 5/16 inch
-62	407-0553-00			1	EXTENDER-RETRACTOR, Knob
-63	- - - - - -			1	BRACKET, variable resistor
	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-64	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch

[1]Replace only with part bearing same color as the original part in your instrument.

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
1-65	344-0189-00			2	CLIP, capacitor
	- - - - - -			-	mounting hardware for each: (not included w/clip)
	211-0601-00			1	SCREW, sems, 6-32 x 5/16 inch, PHB
-66	210-0407-00			1	NUT, hex., 6-32 x 1/4 inch
-67	131-0566-00			25	LINK, terminal connector
-68	131-0593-00			6	TERMINAL, pin, 1.15 inches
-69	131-0590-00			74	TERMINAL, pin, 0.71 inch
-70	131-0608-00			24	TERMINAL, pin, 0.365 inch
-71	131-0707-00			6	CONNECTOR, AWG 22 to 26 wire
-72	352-0164-00			1	HOLDER, terminal connector, 6 terminal
-73	351-0185-00			3	GUIDE-POST, lock
-74	351-0188-00			7	GUIDE-POST, lock
	- - - - - -			-	mounting hardware: (not included w/assembly)
-75	220-0547-01			5	NUT BLOCK
-76	211-0166-00			5	SCREW, 4-40 x 3/16 inch, FHS
-77	211-0105-00			5	SCREW, 4-40 x 3/16 inch, 82°, csk, FHS
	348-0067-00			1	GROMMET, plastic, 5/16 inch
-78	670-1097-00	B010100	B019999	1	ASSEMBLY, circuit board—TIME BASE
	670-1097-01	B020000	B049999	1	ASSEMBLY, circuit board—TIME BASE
	670-1097-02	B050000	B100000	1	ASSEMBLY, circuit board—TIME BASE
	670-1097-03	B110000	B129999	1	ASSEMBLY, circuit board—TIME BASE
	670-1097-04	B130000		1	ASSEMBLY, circuit board—TIME BASE
	- - - - - -			-	assembly includes:
	388-1331-00	B010100	B049999	1	BOARD, circuit
	388-1331-01	B050000		1	BOARD, circuit
-79	214-0579-00			22	PIN, test point
-80	136-0337-00			1	SOCKET, relay, 8 pin
-81	136-0220-00	B010100	B049999	28	SOCKET, transistor, 3 pin, square
	136-0220-00	B050000		27	SOCKET, transistor, 3 pin, square
-82	136-0235-00			1	SOCKET, transistor, 6 pin
-83	136-0263-00			42	SOCKET, pin terminal
-84	131-0608-00			6	TERMINAL, pin, 0.365 inch
-85	200-0945-00			1	COVER HALF, transistor, temp stabilizer, dual
-86	200-0945-01			1	COVER HALF, transistor, temp stabilizer, dual, threaded
-87	211-0062-00			1	SCREW, 2-56 x 5/16 inch, RHS
-88	211-0155-00			5	SCREW, 4-40 x 0.081 inch, knurled
-89	361-0238-00			5	SPACER, sleeve
-90	388-1432-00			1	BOARD, circuit, shield
-91	670-1098-00	B010100	B099999	1	ASSEMBLY, circuit board—TRIGGER
	670-1098-01	B100000		1	ASSEMBLY, circuit board—TRIGGER
	- - - - - -			-	assembly includes:
	388-1332-00			1	BOARD, circuit
-92	136-0220-00			34	SOCKET, transistor, 3 pin, square
-93	136-0235-00			1	SOCKET, transistor, 6 pin
-94	136-0263-03			27	SOCKET, pin terminal
-95	131-0608-00			4	TERMINAL, pin, 0.365 inch
-96	214-0579-00			13	PIN, test point
-97	337-1237-00			1	SHIELD, electrical
-98	211-0155-00			5	SCREW, 4-40 x 0.081 inch, knurled
-99	361-0238-00			5	SPACER, sleeve

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
1-100	214-1140-00			10	SPRING, helical compression
-101	351-0155-00			8	GUIDE, terminal lead
-102	131-0755-00			4	CONNECTOR, terminal, AWG 28 to 32 wire
-103	131-0512-00			4	CONNECTOR, terminal (coaxial cable)
-104	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
	210-1092-00			3	WASHER, flat, 0.147 ID x 0.312 inch OD
-105	210-0407-00			3	NUT, hex., 6-32 x 1/4 inch
-106	352-0222-00			3	HOLDER, cable
-107	386-1657-00			5	SUPPORT, circuit board, for 0.185 inch board height
-108	386-1559-00			2	SUPPORT, circuit board, for 0.47 inch board height
-109	352-0157-00			1	HOLDER, lamp
-110	378-0602-00			1	LENS, lamp
-111	200-0935-00			1	CAP, lamp holder
-112	131-0809-00			1	TERMINAL, stand off
	- - - - - -			-	mounting hardware: (not included w/terminal)
-113	131-0664-00			1	CONTACT, electrical, shaft ground
-114	211-0105-00			1	SCREW, 4-40 x 3/16 inch, 100° csk, FHS
-115	352-0165-00			1	HOLDER, terminal connector, 7 terminal
-116	131-0707-00			22	CONNECTOR, AWG 22 to 26 wire
-117	352-0162-00			1	HOLDER, terminal connector, 4 terminal
-118	352-0169-00			6	HOLDER, terminal connector, 2 terminal
-119	131-0708-00			3	CONNECTOR, AWG 28 to 32 wire
-120	348-0157-00			2	SHIELDING GASKET
-121	366-1058-05			1	KNOB, latch
-122	214-1095-00			1	PIN, spring, split
-123	105-0076-00			1	RELEASE BAR, latch
-124	214-1280-00			1	SPRING, helical extension
-125	105-0075-00			1	BODY, latch
-126	214-1054-00			1	SPRING, flat, latch detent
-127	333-1165-00			1	PANEL, front
-128	386-1447-13			1	SUBPANEL, front
-129	386-1402-00			1	PANEL, rear
-130	214-1061-00			1	SPRING, flat, sliding ground
-131	426-0505-04			1	FRAME SECTION, top
-132	426-0499-04			1	FRAME SECTION, bottom
-133	213-0192-00			8	SCREW, thread forming, 6-32 x 1/2 inch, Fil HS
	361-0326-00			1	SPACER, sleeve (not shown)
-134	337-1064-00			2	SHIELD, electrical
-135	348-0157-00	B010100	B079999	2	SHIELDING GASKET
	348-0235-00	B080000		2	SHIELDING GASKET

STANDARD ACCESSORIES

	070-0975-00			1	MANUAL, instruction (not shown)

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.

7B50 EFF SN B150000-up

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

C788	283-0198-00	.22 µF, Cer, ±20%, 50 V
R788	315-0623-00	62 k, 1/4 W, 5%

ADD:

L266	276-0569-00	Core, Toroid Ferrite

C788 and R788 are located on the Time Base Circuit Board shown on schematic diagram 5. L266 is added in the emitter lead of Q266 on the Trigger Generator Board shown on diagram 2.